Annual Report

of the

Department of Agriculture in the Bombay Presidency

For the Year 1922-23

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ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, BOMBAY PRESIDENCY, 1922-23.

The year 1922-23 was on the whole one of prosperity, though the fall in the prices of most of the staple products of the Bombay Presidency, with the exception of cotton, has made it far less prosperous to the cultivator than it would appear at first sight, and though there was a large area in the southeast of the Presidency where the rain was very deficient and the crops consequently very poor. But the general standard of production was such as to give the methods of cultivation advocated by the Agricultural Department a real chance with, on the whole, satisfactory results. And, moreover, the conditions were favourable in most areas for the research and investigation which must form the real basis for future agricultural progress.

2. It becomes increasingly clear, however, that technical progress in agriculture is by no means an easy matter. All the obvious methods of increasing production by copying methods useful abroad, by trying varieties of crops found valuable elsewhere, by using systems of manuring which seem certain to yield very good returns, have either failed or yielded only partial success. When varieties of seed from other areas have been tested, it has generally been found that the local type was the best. When artificial manures have been used on the model of methods used in England and America, they have often, nay most frequently, proved unsatisfactory, either because they did not give the expected results or else because it was obtained at too great a cost. Such illustrations might be multiplied, and it has become evident that to solve most of our problems means facing them by rigorous scientific methods. Such methods are necessarily slow, but in the efforts at agricultural improvement apparently short cuts have generally proved fatal. And our experience has been that what at first was the longest way of tackling a difficult task has generally given in the end not only the quickest results, but the only results of value that have been obtained.

3. I will indicate the more important investigations now in progress, the results obtained in each of them so far, and the extent to which these have been applied in practice.

I.—*Agricultural Research and its Application.*

4. *Cotton.*—The most prominent work of the Bombay Department of Agriculture has always been on cotton, our greatest crop in point of value, and in several directions substantial progress has been made during the year under report. In the work of producing and extending the use of improved cottons, South Gujarat stands first in point of success. In the tract south of the Narbada river the pure strains of Navsari cotton seed first distributed widely in 1919 have now spread all over the area in question and are rapidly replacing the former mixed seed in use. Including the areas in the Baroda, Rajpipla and other States, seed for over two lakhs of acres were distributed by the Agricultural Department's organisation in 1922, and the character of the district as a producer of staple cotton has been almost re-established. It is now rare to find more than two to three per cent. of *goghari* (the inferior types previously grown) in any part of the area south of the Narbada. North of this river the seed has not proved so acceptable, as the ginning outturn of the *kapas*. though higher than that of most of the staple cottons hitherto, is lower than that of the mixed crop now usually produced, and it has been necessary to breed a new cotton, by hybridisation, to suit the tract. This has now, I think, been secured by the cotton breeder working on the Surat Farm, and another year will show certainly whether this is the case. The new cotton has the staple of the best Surat types, and a ginning outturn of over forty per cent.

In North Gujarat the position is equally promising though we have not got so far with the establishment of improved cotton types as in the South. As a result of a number of years' work at Viramgam and elsewhere, several selected types of *wagad* cotton have been established, in a pure condition, of considerably better staple and with a higher ginning outturn than those commonly grown. These are now being multiplied, and within a couple of years will be available on a large scale. This is one of the cases in which, having got so far, I am impatient to have seed for wide distribution, but we cannot hurry things very much, as there is only one crop a year, and the area under a particular cotton can only be multiplied by twelve times in a single season, if all goes well and the rainfall is satisfactory.

In Khandesh the work has been to improve the type of cotton now grown and especially to get something better in staple than the "N.R." cotton we have been distributing for a number of years, without sacrificing yield or ginning outturn. This has now been apparently secured by the Cotton Breeder at

Dhulia in certain strains of cotton isolated from a supposed cross between *bani* and *comilla* cottons made a number of years ago. These have been exceedingly well reported upon by the trade, and classed as staple cottons, while the yield and ginning percentage is practically as good as the best "N.R." Khandesh types. The seed is now being tested and multiplied on a larger scale, and should be capable of giving us commercial quantities in a couple of years more, with a staple a quarter of an inch higher than the ordinary Khandesh production. On the other hand, the search for better types in the ordinary mixture of cottons now grown in Khandesh has been very disappointing, and hardly any strains have been isolated of real value. The search for such strains is now to be carried much further afield, particularly in Central India.

Increase in yield of cotton is being sought by the people in Khandesh by the use of oilcakes, and particularly by castor cake as manures, which is rapidly increasing. This is interesting as it represents perhaps the first case in which there has been widespread use of concentrated manure on what is essentially a dry unirrigated crop in Western India. This is being pushed and a leaflet is under preparation in connection with it.

In the Karnatak the success of the Agricultural Department in producing improved types of cotton by selection has been in some ways greater than anywhere else. The "Dharwar No. 1" cotton, isolated by the breeders of the Department, is now rapidly replacing the ordinary Kumpta cotton in the Dharwar, South Bijapur, and South Belgaum districts. With the assistance of the Hubli Co-operative Cotton Sale Society and other similar sale societies improved seed for 65,000 acres are being distributed in 1923. This has a ginning outturn much higher than the local Kumpta cotton with an equal staple. Further progress has, however, been made with a series of still better types obtained by crossing the best of the Kumpta cottons with high ginning cottons from Central India and these which have equal staple with the best of the local types with much higher ginning outturn and better colour, are now being multiplied for distribution. Another feature in the improvement of Kumpta cotton is the question of cleanliness, for it is notoriously the dirtiest cotton in India. A clean picking campaign has been instituted this year, in co-operation with the Hubli Co-operative Cotton Sale Society, with considerable success, and I can see the likelihood of much improvement in the course of the next two years. I must also refer to the improvement effected so far in the American cotton grown in

Dharwar. The selected type we have evolved known locally as "Upland" or "Gadag No. 1" is rapidly becoming universally grown in this area, and in co-operation with the Gadag Co-operative Cotton Sale Society, seed for 63,000 acres is being distributed in 1923. We have further improvements in this cotton in hand, and we are on the one hand testing strains of American cotton received direct from America, and on the other endeavouring to obtain further improvement by crossing our best Dharwar-American types with others from America.

In Sind no further progress has been made in evolving better types of *deshi* cotton, as the so-called "27 W.N." cotton has proved its value and can now be distributed on a large scale. Peculiar difficulties have arisen in keeping this type pure in Sind, and the amount of reliable seed available is limited. Until sufficient seed is available to cover the tracts needing the cotton a local type known as "Bhitshah" seed is also being distributed but within a year or two enough authentic seed will be available to fill all demands, if we can only find means as we have done elsewhere to maintain its purity when it has entered into large scale cultivation. The improvement of American cotton in Sind, where the Punjab variety known as "F-4" has become the standard type in the Jamrao tract which alone is at present suitable for American cotton, has been taken in hand more seriously than ever before, and a large number of the best American types have been tested as a preliminary to crossing. Two of these "Webber No. 49" and "Durango" seem to be of peculiar value, and have yielded very high returns of cotton of staple of over $1\frac{1}{8}$ inches. The final sanction to the proposal for building the Sukkur barrage and canals which will enormously extend the area suited for American cotton, has given a stimulus to this work, and it is very important that we should have a first class type ready for distribution when the water is ready for the land. American cotton can only be grown where there is a reliable water supply from the beginning of May at least.

So much for work in improving the types of cotton grown. The progress of cotton growing depends, however, also on the increases of yield by prevention of the losses occurring every year due perhaps chiefly to shedding of the bolls, to the attack of bollworm and to the attack of cotton wilt. Our workers at Surat and Dharwar in particular have tackled these problems, and though final conclusions have been reached, I may say that at Surat there is very great probability that the bollworm (in this case the "spotted bollworm") can be dealt with by means

of parasites which are now under study. Definite results will probably be available next year. So far as cotton wilt is concerned, we have discovered strains of cotton both in Gujarat and in the Karnatak which are very much more resistant to wilt than those now grown, and also a type from Burma (*wagale*) which seems almost entirely immune. Starting from these as a basis, it would appear to be only a matter of time before we can issue seed giving plants immune to the disease, and yet possessing all the other desirable qualities demanded.

Future work on cotton will be much intensified because of grants offered by the Indian Central Cotton Committee, and accepted by Government, for the investigation of four specific problems of cotton cultivation. These are as follows :—

(*a*) Annual grant of Rs. 25,000 for three years at least for the investigation of the Physiology of Cotton Flower and Boll Shedding in Gujarat.

(*b*) Annual grant of Rs. 15,000 for three years at least for the investigation of the Spotted Bollworm in cotton and the methods for its control.

(*c*) Annual grant of Rs. 25,000 for three years at least for the investigation of Cotton Wilt in the Karnatak and the methods for its control and also for the further improvement of the Dharwar-American cotton in the same area.

The work to be undertaken under these grants is now being organised, and will be in full swing during the greater part of the 1923-24 season.

5. *Rice.*—Since the establishment of the Karjat Rice Research Station in 1919, work on this crop has been among the most important research activities of the Department, with results which have fully justified the expenditure. The primary work done there has been the isolation of pure strains from the *Kolamba* rice chiefly grown in the North Konkan, which while equal to the ordinary type in fineness have a materially greater yield. This particular variety of rice is grown on about 200,000 acres in the Kolaba, Ratnagiri, Thana and Surat Districts and any improvement made will, of course, be applicable over this area. The results have been remarkable and three strains have been isolated which give a very much higher yield than the ordinary seed and are suitable for the slightly varying conditions in the tract. These were grown on a large enough scale during the past year in cultivators' fields to test their capacity, with

the result that they gave respectively 27·5 per cent., 25·6 per cent. and 16·3 per cent. more yield than the ordinary types. They have already got a local reputation and are in demand. About 1,200 acres are planted with them in 1923, and we are organising their distribution to at least 10,000 acres in 1924 in the Panwel, Pen and Karjat talukas of Kolaba and the Kalyan taluka of Thana. The whole area should be covered within three or four years if the supply of the seed on a large scale can be organised and financed. This is, of course, only the beginning, and the plant breeding expert is now turning his attention to getting still better types by selection, or by crossing with high yielding coarse rices, with a view to getting the high yield of these varieties combined with the fineness of Kolamba strains.

The results have been so striking that Government has sanctioned during the year the extension of similar work in the *Mallad* tract of the Karnatak, in the South Konkan area, and in the rice growing tracts of Upper Sind. A special station has been established for this purpose in the Karnatak at Mugad near Dharwar, and the work there placed in the hands of Mr. S. G. Bhalerao, who has hitherto been the resident officer in charge of the work at Karjat. The work in the South Konkan will be conducted on the Ratnagiri Farm, under the close personal control of Mr. V. G. Gokhle, Deputy Director of Agriculture, Konkan. In Sind, the investigations are being done on the Larkhana Farm, and will be under the direction of Mr. K. I. Thadani, Cotton Breeder, with suitable assistance. In each case rigorous scientific methods are being employed and practical results, applicable on a large scale, may be expected in three or four years.

In the case of rice, side by side with the selection and breeding work already described, a very careful investigation is in progress regarding the cultural conditions which result in large yield. The results so far have cleared up many points. No cultural method, including manuring, has led to increase in the size of the ear heads in any particular type of rice, and any improvement in yield by cultural methods must therefore depend on the increase in the number of ear heads per acre. To do this, after much investigation, we find ourselves reduced to methods of manuring, and the exact methods of carrying this out, and their influence on the plant at each stage is the matter under special inquiry at present. A bulletin is now in the press giving a full account of the results of this work up to the present.

In actual practice the manuring of rice only makes slow progress. In the laterite area of the south Konkan and *Mallad* our results with bonemeal have been very remarkable and consistent,—the increases in yield obtained by applying 220 pounds of bonemeal per acre to the rice in the field have in many cases been from fifty to one hundred per cent. Despite this fact, the extension of the system is slow. A leaflet has been issued during the year, and intensive propaganda is in view. The figures given, it must be understood, are for the rice growing areas in the laterite regions; the method has given far less result in the remainder of the Konkan.

6. *Nagli* or *Ragi*.—The most important grain in the heavy rainfall tracts of the Bombay Presidency, next to rice, is *nagli* and in these regions it is grown over the upland areas. The crop is supposed to be an inferior one, relegated to poor land, but it remains the food of the poorer classes over very large areas. Experiments with a view to improve the yield by selection were taken up at a special research station at Hatkhamba near Ratnagiri two years ago, and have already yielded remarkable results. One strain has been isolated yielding four times the amount given by the local type, and about twelve strains which yield double. These strains have to be tried on a larger scale before we can speak with complete certainty, but I think there is little doubt that we shall have, for distribution, seed of *nagli* within two years, which will yield double that at present grown over between four and five lakhs of acres.

7. *Jowar*.—The Cotton breeders at Dharwar and Surat as well as the Deputy Director of Agriculture, Sind, have recently taken up the study of the Bombay types of *jowar* with a view to an increase in yield. In Sind little has been done except to make a collection of the local types at Larkhana, but at both the other centres mentioned considerable progress has been made in the isolation of promising pure strains from the best local varieties and it will only be possible to measure the likelihood of a big advance in the yield of *jowar* types in next year's report. The matter is, however, so important, for this crop covers more than eight and a half million acres in the Bombay Presidency, that Government have during the year sanctioned the provision of special graduate assistance in this investigation.

The yield of the *jowar* crop is annually reduced to an extent of probably at least fifteen to twenty per cent. by two diseases. The first of these is the smut disease, the second is the insect

known as the *jowar* borer. The first can be dealt with, in its most frequently occurring forms, by steeping the seed before planting in a solution of copper sulphate. During the past season a very energetic propaganda has been conducted, with the close co-operation of the officers of the revenue department, to get this treatment very widely adopted. The results have been that for the *kharif* crop of 1923, the seed for at least one and a half lakhs of acres have been steeped with perfectly successful results. A further campaign is in hand for the *rabi* crop, the results of which are not yet available. It is my ambition to make this treatment, which costs only one pice per acre, universal in the *jowar* area within five years. If this is done it will mean the addition of at least from five to ten per cent. of the crop of this grain.

The other great pest of *jowar* is the *jowar* borer, the severity of whose attack varies, but which rarely causes a loss, on the *kharif* crops, of less than five and often of more than ten per cent. This has been under investigation for the past three years at Surat, through the help of a grant made by the Sir Sassoon David Trustees. The study has carried us very much further towards a full knowledge of the past, and has led to a certainty that the main source of its continuance is the fact that the pests hibernates in the *jowar* straw (*kadbi*), which is stored all over the country for fodder. Mr. T. N. Jhaveri, who has been specially in charge of this work, is now engaged in devising methods by which a large proportion of the hibernating insects can be destroyed, and the outlook is decidedly hopeful.

8. *Bajri.*—The question of the improvement of this crop which is the typical *kharif* grain grown in the famine areas, has been before the department for several years. The investigation is financed by the Sir Sassoon David Trustees, and the actual work is under the control of Dr. Burns. The inquiry is difficult, partly because so litte is known of the botany and biology of the crop and partly because the flowers are usually cross fertilised and hence no pure types exist. Continued selection is, however, resulting in the production of types of high yield and apparent draught resistance. I cannot promise early results in connection with the production and distribution of types of high yielding draught resistant *bajri*, but we are undoubtedly getting nearer to this desirable consummation. In the meantime, I may call attention to the continued success of Akola *bajri*, when grown in Khandesh. Its distribution is very popular, and this simple transfer normally results in an increase of more than twenty-five per cent. in the yield.

9. *Wheat.*—Work on the improvement of the types of wheat grown has been carried on both in the Presidency proper and in Sind. In the former case it has been under the charge of Mr. R. K. Bhide, who has now got a number of pure strains of wheat suitable for the Deccan, with a much higher yield than the local types. These only need multiplication and this is now taken in hand. When obtained in sufficient amount they will be suitable for growing in the great wheat areas of the Ahmednagar and Nasik districts. Some quantity should be available for such distribution next year.

The variety of wheat known as "Pusa 4" continues to give excellent results in the Panch Mahals, and in North Gujarat generally. The organisation of the distribution of this seed is a very important part of the duties of our district staff in these areas. The quality and yield are so superior to the local varieties that I am informed that often no less than fifty per cent. more value per acre has been obtained by its use.

In Sind, however, the wheat crop is more important than anywhere else in the Bombay Presidency, and here we have a special farm near Jacobabad for the study of the crop and multiplication of desirable types of seed. The "Pusa 12" and "Punjab 11" strains of wheat still remain the best and most popular types, and the demand is so great that a large import of wheat seed of the former kind was arranged for from the United Provinces. Our own farm only yields enough seed to plant 1,000 acres, and so such import is necessary, especially in view of the fact that the recovery of seed from the growers has been found more difficult than in other parts of the Presidency. At the same time, in Sind we have proceeded also by isolating types from the best local wheat, and have secured some exceedingly good material for multiplication.

10. *Tobacco.*—In my last report I referred to the initiation of careful botanical study of tobacco at Nadiad (North Gujarat) with a view to the development and maintenance of the best and most suitable types of tobacco in that area. This has continued during the present year on the station belonging to the Nadiad Agricultural Association, the plan being to lay ourselves out primarily to produce the best pure types suitable for the local market. We have already isolated a number of different types, but it will be two more years before very definite results can be obtained.

11. *Sugar Cane.*—The long continued work on the Manjri Farm, in which the most economical methods of cultivation and types of cane have been investigated for a series of years

has now borne fruit. All the details of the "Manjri method" have not proved acceptable to the people, but many of them are now in very general use, particularly in the newer Deccan Canal areas. The method of planting in rows, intercultivation by bullocks, use of sulphate of ammonia in combination with oil cake as a manure for top dressing, these and several other Manjri modifications of the cultivation in vogue, are now widely adopted. With regard to the general widespread use of Sulphate of Ammonia as a manure for sugar cane, it is interesting to recall that the actual entry of this material into the ordinary economy of the crop may be largely traced to a special grant of Rs. 10,000 placed at our disposal in 1919-20 by the Sir Sassoon David Trutees for the purpose of demonstration. Varieties of sugar cane tested at Manjri are now replacing the old type under special conditions, such as the *Manjav* cane for waterloggged land. The investigations at Manjri now consist chiefly of further tests of varieties, of trials designed to show how best to apply water, and in what quantity, and in attempts to reduce the cost of cultivation, and yet at the same time secure a good crop. The position of the sugar cane industry under the Deccan canals has very considerably changed during the past two or three years. The fall in the price of *gul* to very little more than pre-war prices will enforce economy in growing the crop which were hardly thought of a little time ago, and probably lead to a diversification of crops in these tracts, which will be ultimately all to their advantage. In the meantime the economies already worked out as part of the Manjri system are being pressed all over these tracts.

In view of criticisms made, of the findings of the Indian Sugar Committee, and of the recent fall in the price of *gul*, the work of the Manjri farm has been reorganised during the year, and the results will, it is hoped, meet the demands upon it as the central experimental station for sugar.

12. *Potatoes.*—We have spent a good deal of time and money during the last few years on the investigation of the difficulties of potato cultivation in the Deccan. These are now bearing fruit, and in the greatest potato tract, north of Poona, many of the recommendations made as a result of these investigations are now being widely adopted. The study of the *tambera* disease, the most important enemy of the *kharif* crop, has continued a stage further, and the dusting of the crop with sulphur is now recognised as a practical method of dealing with it, and is in demand by the cultivators, who are willing

to pay for it. Fumigation against potato moth is also taken up widely this year, when the attack of this pest has been particularly severe. Further investigations are now in progress in finding a more suitable type of seed potato. Some recently imported from Scotland seem to have great promise. Moreover, the Horticulturist (Mr. Cheema) has obtained some very promising types from potato seed which set three years ago at Ganeshkhind. Again as the question of satisfactory storage through the hot weather is vital to putting this potato industry in a satisfactory position further experiments are in progress in this direction, including an attempt to see if cold storage is applicable and economical under our conditions. The whole work on potatoes has for a number of years been largely financed by the Sir Sassoon David Trustees, and without their aid the work would probably never have been done.

13. *Cardamoms.*—I must again refer to the work done by Mr. D. L. Sahasrabudhe in the *Katte* disease of cardamoms, which seems likely to ruin the cardamom growing industry in North Kanara. He has cleared up the nature of the disease, and has elucidated the cause and the method of the attack. Whether the methods which he proposes for dealing with the disease on a large scale will have the effect of rehabilitating the industry, time only can show. This inquiry has also largely been financed by the Sir Sassoon David Trustees.

14. *Fruit Crops.*—During the year 1921-22, a special horticulturist was appointed in the person of Mr. G. S. Cheema, and he with a staff for investigation, teaching, and district, has been principally devoting his attention to the study of fruit and its improvement, as well as to the improvement of the marketing of fruit products. So far as the improvement of fruit types is concerned the matter is only in the very first stages. In the case of grapes, a large number of seedlings are being raised, which are growing luxuriantly and show large variations, but the time has not yet come to test their quality. Similarly an extensive crop of banana seedlings has been successfully raised in an attempt to develop new types. One of the very interesting results obtained during the year is the increase of yield in fig trees as a result of notching the branches, and this will be done on a large scale in 1923-24 in the gardens of fig growers of Poona. The diseases of citrus fruits, which are next to mangoes our most important fruit crop, have received a good deal of attention during the year. The orchards in Khandesh particularly are found to be very badly attacked with scale insects and the white fly, and a campaign of spraying is

proposed for the coming season. The moths which puncture orange fruits have been shown to be very common, but a very simple way of minimising the attack by handpicking the moth at night has been shown to the people, and is to be further demonstrated. But the most serious disease of oranges is the 'die-back' of the branches and even of whole trees which is a feature of most of the gardens in the Presidency, and this is now under careful study. It will, however, be some time before really reliable results can be obtained in this connection.

The question of the development of fruit cultivation in Sind has been seriously considered during the year, and definite proposals in this connection are now before Government.

15. *The Checking of Pests and Blights of Crops.*—I have already referred under previous headings to the work undertaken to investigate the disease and pests of cotton, of *jowar*, of potatoes, of cardamoms, and of certain fruit crops. Leaving aside the studies of minor crop pests, I must speak of attempts to check the damage done by the *Katra* caterpillar in Gujarat, by the *Koleroga* disease of betel nuts, and by the larger crustacean and vertebrate pests over very wide areas.

The *katra* caterpillar (*Ansacta moorei*) is one of the most important pests of ordinary cereal farm crops in Upper Gujarat and especially in the Panch Mahals. There the people look upon it in many areas as their principal enemy and it not frequently leads to the complete loss of the crop. We proved last year that it could be checked by dusting with a mixture of Paris Green and lime, at a cost not much exceeding Rs. 2 per acre, and the results have been confirmed over a large area during the present year. The trouble is now that the dust appears to wash off easily in rainy weather, but we have evidently the basis of a practical method which demands more careful study in the coming season.

The *Koleroga* disease of betel-nuts is one of the most serious blights of that very important crop in the Konkan and in North Kanara, and it has appeared very badly in the current year. It can be completely kept under control by spraying with the so-called Bordeaux mixture, which is a mixture of Copper Sulphate and lime. The demand for this treatment is increasing and is available now in two of the largest betel nut growing tracts to the extent that our staff can cover. It is so simple, however, that once a garden owner has seen it done, there will be no difficulty in getting a sprayer and doing it himself.

The various species of land crab are among the very serious pests of cultivation over much of the rice area, both in the Presidency Proper and in Sind, for these animals not only undermine and perforate all the field embankments but cut off the seedlings and even in some cases climb up the flowering rice plant and eat the head. Little has been hitherto known of the life-history and habits of the animals, which is an essential preliminary to dealing with them, but during the past two years very extensive observations and cultural experiments have been made on two of the principal species at Karjat, by Mr. P. V. Wagle, and before the end of the current year, I think the problem of dealing with them will have been to all intents and purposes solved.

With this latter I must also speak of the damage done by the field rat, particularly in Sind, chiefly to rice and also to other crops. In Lower Sind, in fact, its depredations are the most frequent complaint of the Zemindars. A preliminary inquiry into its habits has been made during the year under report and it is hoped that serious study can be done in the coming season. We know little of the habits of the animals under Sind conditions, but the fact that genuine plagues of field rats are of frequent occurrence, it is time that the whole question should be thoroughly studied.

One of the most widespread pests of all cultivation, especially in the tracts near the Western Ghats or near forest areas, as well as in the sugar cane areas is the wild pig. A Committee, with Dewan Bahadur K. R. Godbole, M.L.C., as Chairman and the Director of Agriculture as Secretary was appointed in February 1922 and has reported during the current year. Their study of the subject is a very thorough one, and their report is now before Government.

16. *Increase of Yield by Cultural Methods.*—In the famine areas the main problem is to make the most use possible of the rain which actually falls, and while no new principle has developed during the year, the application of the method of conserving moisture by repeated shallow hoeings is widening. In Sholapur, where it has been most successful before, the conditions were so bad in 1922 as to make even this method of saving the crops almost useless, but it was applied with success in the north-east talukas of the Ahmednagar district, and I was glad, a few days ago, to see the people of a village in the West Khandesh district speaking with enthusiasm of the system. The whole question of the retention of water in the soil, has, however, been made during the year the principal work of the Soil Physicist (Mr. V. A. Tamhane), and he has been provided with a place for the study and staff at the Manjri farm. Results

from this study, and practical methods for their application may be expected within two or three years.

Last year I referred to my report to the very great success which has been obtained as a result of cultivation on ridges in the black soil of the Surat district. This has been amply confirmed in the year under report. and suitable implements have been found for making the necessary ridges. This method, which has resulted from twenty years of study at the Surat farm, promises to be a very great advance in south Gujarat, and energetic propaganda is being undertaken in connection with it.

17. *The Improvement of Implements.*—Though one of the very early improvements introduced by the Agricultural Department was the iron turnwrest plough for the black soil areas, and though this type of plough, of various makes, is still extending its use by leaps and bounds, yet other advances in implements have been few, and not very popular. A Committee was appointed by Government early in the year under report to consider how work in this direction can be speeded up and made more effective.

The following is a summary of the main conclusions of the Committee which have been accepted by Government:

"The designing of new and improved implements should be an important function of the Agricultural Engineer, working in conjunction with the Deputy Directors of Agriculture. Investigation in connection with implements other than ploughs is very necessary:

2. The production of working models should be arranged by the Agricultural Engineer at the Dapuri Workshops and funds should be arranged by the Agricultural Engineer's budget to allow him to do so.

3. Successful designs which promise to have an effective demand should be placed before all manufacturers, who are interested.

4. The propaganda required for the introduction and extension of the use of implements should be under the control of the Agricultural Department. Even in the case of the 9 inch plough, with which most progress has been made, propaganda and demonstration are still required.

5. Propaganda should be carried on by the territorial staff of the Agricultural Department, assisted by and in co-operation with the various local popular organisations including co-operative societies in the districts."

There are many inquiries continually being made regarding the use of motor tractors in connection with land cultivation, and the results of tests extending over several years have been incorporated in a bulletin by the Agricultural Engineer now being prepared by the press. The fact is clear that motor cultivation can only be useful when the unit area of cultivation is twenty acres or more, and hence it is not applicable over most of the cultivated area of the Bombay Presidency. Moreover, many of the smaller types of tractor such as the Fordson are unsuitable for the black soil areas, though they are very useful in the alluvial country of north Gujarat or Sind. The possibilities of the heavier types of wheeled tractors and of the 'Caterpillar' tractors now on the market have been investigated, and final tests with the former will be made on a large scale in the coming season, both in Gujarat and Khandesh, where we are offering to plough land at a definite rate up to the limit of the capacity of the tractors used.

18. *Cattle Improvement.*—The work of the Agricultural Department in this direction has consisted in the establishment of standard herds (1) of Kankrej cattle at Chharodi in Upper Gujarat and (with special reference to milking qualities) at Surat, (2) of Amrit Mahal cattle at Bankapur in the Dharwar district, (3) of Sindhi cattle at the Willingdon Cattle Farm at Malir near Karachi in Sind, and at the Agricultural College dairy in Poona. With regard to the Willingdon Cattle Farm, this has been transferred to the management of the Agricultural Department during the year and has been placed, like those at Chharodi and Bankapur, under the management of the Deputy Director of Agriculture for Animal Breeding (Mr. E. J. Bruen). These form the nucleus herds for the study and improvement of the breeds involved and in all the cases I may say that the standard of the animals is far higher than the average of the country. The breeds at Bankapur and Malir being new, have not yet reached the high standard of some of the older forms, but that is a matter of time.

During the previous year Government appointed a Committee to consider the question of cattle improvement and fodder storage in all its aspects, whose Chairman was Rao Bahadur G. K. Chitale, M.L.C., and whose Secretary was the Deputy Director of Agriculture for Animal Breeding. Its report is now received and is under the consideration of Government. The developments recommended are very extensive, and the whole matter will be placed before the Provincial Board of Agriculture before any final steps are taken.

19. *General*:—The research required for agricultural improvement is chiefly done in connection with various farms and research stations in the Presidency, and gradually these farms are becoming more and more devoted to the study of scientific questions. Leaving aside the farms specifically maintained as seed farms, the list of those now kept up and the particular purpose they are intended to serve are as follows. Beyond the purposes specified it must be understood that every station is a centre for agricultural information and for help to cultivators who ask for it.

I.—*Gujarat Division.*

Name of the Farm.	Special purpose.
(*a*) Surat Farm	(1) Breeding of Improved Cotton and *jowar* for Lower Gujarat and multiplying the seed of these. (2) Cotton Research Work financed by the Indian Central Committee. (3) Study of *jowar* borer. (4) Experiments on improvements in cultivation in the Gujarat Black Soil Areas. (5) Improvement and Maintenance of breed of Kankrej cattle developed as a milk breed.

Broach Farm is practically a substation of Surat for purposes (1) and (2) :—

(*b*) Nadiad Station ..	1. Breeding pure strains of tobacco suitable for north Gujarat.
	2. Investigating the cultural difficulties of tobacco in the Kaira district.
(*c*) Viramgam Station ..	1. Breeding of Improved Cotton for the Dholleras area.
(*d*) Dohad Farm ..	1. Wheat selection, breeding and multiplication for the Panch Mahals.
	2. Study of methods of cultivation and crops suitable under irrigation cultivation in the Panch Mahals.
(*e*) Amalsad Farm ..	1. Study of Red Rot of Sugar-cane in south Gujarat.
	2. Introduction of varieties of sugar-cane not susceptible to red rot.

II.—*Khandesh and Nasik Division.*

Name of the Farm.	Special purpose.
(*a*) Dhulia Farm ..	1. Breeding of improved cotton for Khandesh and multiplying the seed.
	2. Maintenance of pure supply of Spanish Peanut, Groundnut seed.
	3. This farm also serves as the school farm for the Dhulia School.
(*b*) Jalgaon Farm ..	1. This is almost entirely a farm maintained for the testing, multiplication and growing of improved cotton seed for Khandesh.

III.—*South Central Division.*

(*a*) Manjri Farm ..	1. This is our main sugarcane research station, for investigating all problems connected with this crop in the Deccan Canal areas.

Baramati Farm is practically a sub-station of the Manjri Farm.

(*b*) Kopargaon Farm ..	1. Station for sugarcane study in the Ahmednagar District. In this respect it is practically a sub-station of the Manjri Farm.
	2. Fodder (*kadbi*) growing, shredding and baling station for famine purposes.
(*c*) Mohol Plot ..	1. This is maintained simply for the multiplication of cotton seed suited to the Sholapur District and for testing and showing methods of dry cultivation.

IV.—*Southern Division.*

(*a*) Dharwar Farm ..	1. Breeding of improved cotton and *jowar* for the Karnatak areas, and multiplying the seed.
	2. Cotton research work on Cotton Wilt Disease and on the improvement of Dharwar-American Cotton financed by the Indian Central Cotton Committee.
	3. Experiments on improvements in cultivation in the Dharwar area.

The Mugad Rice Station may be considered as a sub-station of Dharwar for the study of rice improvement for the *mallad* tract.

Name of the Farm.	Special purpose.
(*b*) Gokak Farm ..	1. Study of sugarcane and other irrigated crops on the sandy soil of the Gokak Canal area.
	V.—*Konkan Division.*
(*a*) Karjat Rice Station ..	1. Breeding improved rice for the North Konkan.
	2. Study of the rice plant in all its aspects with a view to increasing its yield.
	3. Study of land crabs as an agricultural pest.
(*b*) Ratnagiri Farm ..	1. Breeding improved rice for the South Konkan.
	2. Experiments in new crops and improvements of cultivation in the South Konkan.

The Hatkhamba *varkas* station is a sub-station of the Ratnagiri Farm for the study of *nagli*, and obtaining improved types by selection and breeding.

(*c*) Kumta Farm ..	1. Study of rice problems in North Kanara.
	2. Investigation of most suitable quick growing plants to form *soppu* manure.
	VI.—*Sind Division.*
(*a*) Mirpurkhas Farm and Mirpurkhas Seed Farm.	1. Breeding of *deshi* and American Cotton for Sind, and their multiplication.
	2. Study and propagation of types of fruit (chiefly of citurs) suited to Lower Sind.
	3. Study and improvement of improved implements for Sind conditions.
	4. Study of water "duties" under Sind conditions.
(*c*) Larkhana Farm ..	1. Breeding of improved rice for Upper Sind and its multiplication.
	2. Study of cultural problems of rice cultivation in Upper Sind.
	3. Study of *jowar* varieties and their improvement.
	4. Purification and multiplication of berseem seed.
(*d*) Jacobabad Farm ..	1. Breeding and multiplication of improved wheat seed for Upper Sind.

Name of the Farm.	Special purpose.
(*e*) Sukkur Farm ..	This will probably be abolished during the coming year.
(*f*) Landhi Farm ..	This has been converted into a sub-station of the Willingdon Cattle Farm during the year under report.

VII.—*Cattle Farms.*

(*a*) Chharodi Farm, Upper Gujarat.	1. Study and improvement of the Kankraj Breed of Cattle.
(*b*) Bankapur Farm, Dharwar.	1. Study and improvement of the Amrit Mahal Breed of Cattle.
(*c*) Willingdon Cattle Farm, Malir, Karachi.	1. Study and improvement of the Red Sind Breed of Cattle. 2. (Temporarily) Study and improvement of the Thar Parkar Breed of Cattle.

VIII.—*Agricultural College Section.*

1. Agricultural College Station.	This is the centre for most of the scientific research work of the Department.
2. Ganeshkhind Gardens.	(1) Horticultural investigations. (2) Breeding of improved wheat for the Deccan areas.

II.—*Demonstration and Propaganda.*

20. As I have previously remarked, the one ultimate test of the success of a department of Agriculture, and of the whole of its research educational and other activities is whether the recommendations made are actually brought into practice, and have resulted in increase in the quantity or improvement in the quality of the material produced. As a rule, this will also naturally result in increasing the profit to the producers, that is to say to the cultivators, though this is not the case necessarily, and special organisation may be wanted to secure it. But I want again to lay down clearly that the one purpose of our existence as an agricultural department is the increase in the quantity or the improvement of the quality of agricultural produce, and the consequent increase of the profit to the cultivators.

21. In order to attain this end more completely, a good many changes in organisation were introduced in 1921-22 including a definitely closer co-operation between the Agricultural and the Co-operative Departments, the institution of Divisional Boards which control and the propaganda activities

of both departments and the definite adoption of a system of local development association for the carrying on of agricultural propaganda in areas which desire it. All these changes have developed during the year under report.

22. The Divisional Boards which were created as the result of discussions which took place at the Provincial Board of Agriculture in 1921 have now been working for more than a year in Sind, Gujarat, Khandesh and Nasik, the Deccan, the Karnatak and the Konkan with Kanara. Each of them consists of six members. Two, including the Chairman, are officials, namely, the Deputy Director of Agriculture, and the Assistant Registrar of Co-operative Societies, two are non-officials nominated by the Central Co-operative Institute and two are non-officials nominated by the Director of Agriculture, the nominations in each case being accepted by Government. The Board thus constituted is responsible for the policy of agricultural propaganda and for non-credit rural co-operation including the distribution of Government loans for the assistance of the latter, in the area assigned to them. Their actual duties were defined as follows :—

> "The Boards will control the portions of the Government grant for loans to Agricultural Societies now in charge of the Registrar of Co-operative Societies, and of the discretionary grants for propaganda purposes now in charge of the Director of Agriculture as distributed by these two officers among the divisions. The Boards will also advise on the application of the policy of the two Departments within the division, and will have power to call for any information and data required from the Assistant Registrar or Assistant Registrars and the Deputy Director of Agriculture. The proceedings of these Boards were to be considered by the Director of Agriculture and the Registrar sitting jointly and orders also issued by them jointly."

All the Boards thus constituted have met regularly during the year under report. They have taken their duties seriously, and in several cases they have been most useful in bringing the Agricultural and Co-operative Departments into closer touch with public opinion. They have been particularly useful in the Karnatak, in Sind, in Gujarat and in Khandesh and Nasik, and as they become more established will be able to exert a more effective control of the work. The thanks of the Department is due to the non-official members, who have so kindly placed their knowledge and experience at the service of the Boards. In four cases the functions of the Boards have been enlarged during the year, and each one of the three has, after the addition

of two additional members representing cotton interests and the cotton trade, been established as Divisional Cotton Committees to advise Government regarding all matters concerned with cotton cultivation or trade in their areas. These cases are (1) Sind, (2) Gujarat, (3) Khandesh, (4) the Karnatak. The effectiveness and usefulness of their advice has still to be proved but I think it is certain to be valuable.

23. But the mere direction of a number of official propaganda officers by a Divisional Board, however effectively organised, will not be enough, and it was felt that the development of local initiative in small areas by cultivators themselves was essential to the rapid spread of agricultural improvements and to the organisation of their use. This meant the establishment of local agricultural associations of some sort. Now the success of such Associations in the past has been very varying, but it was felt that it was necessary to provide for (1) a limited area for each association, where the interests were likely to be fairly similar. This was provided by the taluka, (2) a definite interest by Government in the success of each association. This was provided by the offer of a subsidy of any amount up to Rs. 1,000 per annum (but not exceeding half the total expenditure) to each association, provided it satisfied certain conditions, (3) a condition that each such association should employ a paid demonstrator approved by the Agricultural Department for its work, and (4) a condition, likewise, that the annual programme should be approved and the subsidy recommended by the Divisional Board.

Under this scheme, eleven associations have been formed, and the subsidies paid to them before the end of June 1923. The talukas in which these have been established are as follows:—(1) Chorasi (Surat), (2) Pachora and (3) Jalgaon (East Khandesh), (4) Madha (Sholapur), (5) Satara, (6) Khed (Poona), (7) Dharwar, (8) Ron and (9) Gadag (Dharwar), (10) Chikodi and (11) Athni (Belgaum).

In addition to these associations in the following talukas have been approved by the Divisional Boards concerned and the subsidies will be paid as soon as the necessary conditions, particularly with regard to the presentation of a budget, are fulfilled:—(1) Walwa (Satara), (2) Gokak (Belgaum), (3) Sindgi (Bijapur), (4) Sirsi (North Kanara), (5) Hyderabad, (6) Hala, (7) Shahadadpur and (8) Tando Allahyar (Middle Sind), (9) Kambar, (10) Ghotki, (11) Larkhana and (12) Sukkur (Upper Sind).

The associations promise well. Only three of them have as yet completed a year of existence, namely Pachora (East Khandesh), Madha (Sholapur) and Chorasi (Surat) and these on a review of their year's work have done excellent work, and have certainly intensified agricultural propaganda in their talukas to a considerable extent. They have not, on the whole, done much in the direction of co-operative non-credit organisation in their areas, but that will come, as they get settled down to their work. Of these associations to which subsidies have been paid only one has definitely been unsatisfactory. The accounts of each association are audited by the auditors of the Co-operative Department when they are requested under the Co-operative Act, and by the auditors of my office when this is not the case.

Associations organised under this scheme will in all probability gradually replace those on a pure non-official basis which have previously existed. But we can never forget the good work which some of these have done in the past in various parts of the Bombay Presidency. In Khandesh they have been a very important feature of the organisation of agricultural improvement, and some of them will continue to exist in any case. Certain associations have been, and still are bearing at least the financial responsibility of vernacular agricultural magazines. The Deccan Agricultural Association has continued to bring out the monthly *Shetki* and *Shetkari* in Marathi. The Dharwar Agricultural Association has published the monthly *Vakkaligaru Vakkalitanama* in Kanarese and the Broach Agricultural and Industrial Association has continued quarterly the *Gujarat Agricultural and Industrial Quarterly* in Gujarati.

24. I must refer to the account by the Deputy Directors, which form appendices to the present report, for a detailed account of the propaganda work undertaken. The closer co-operation with the Co-operative Department is a continual stimulus to such propaganda in many areas, especially since the agricultural organisers of that Department now work under our control. There is a more active and energetic spirit abroad among our district workers and some of them have been remarkably successful, especially when the large areas each of them has to cover is taken into account. When I consider the progress made now, I feel that, in many parts of the Presidency and in Sind, there is a real awakening to the possible advantages of many of our proposals, which did not exist four or five years ago.

25. In Sind a change in organisation of agricultural propaganda has been made. In Middle and Upper Sind this has

been taken out of the hands of the Deputy Director of Agriculture, who thus becomes simply the controllor of research and investigation so far as these areas are concerned, and placed in those of Khan Bahadur Azim Khan, Assistant Registrar of Co-operative Societies, who has shown special capacity for this class of work. He is responsible for this work direct to the Divisional Board. Moreover, it has been for the present concentrated in eight talukas (Ghotki, Sukkur, Larkhana, and Kambar in Upper Sind, and Shahadadpur, Halla, Hyderabad and Tando Allahyar in Middle Sind), where opportunities for immediate progress seemed greatest. The result so far has been good, and very substantial progress has already been made in these talukas since Khan Bahadur Azim Khan has taken charge. Agricultural propaganda in Lower Sind, and particularly in the Jamrao tract, remains as before und erthe direct management of the Divisional Superintendent of Agriculture (Mr. Gul Mahomed A. Rehman).

26. The propaganda of the Agricultural Department is done in part both directly and indirectly by means of publications, of which the following have been prepared and issued (or arranged for) during the year under report. Some of those announced in last years' report have also been issued during the year :—

Bulletins.

1.	Bulletin 110	.. Year book of the Agricultural Department in the Southern Division (in English and Kanarese).
2.	Bulletin 111	.. A Note on Well Boring (by Mr. W. M. Schutte).
3.	Bulletin 112	.. Improvement of Grazing Areas in the Bombay Presidency (by Mr. L. B. Kulkarni).

Leaflets (with Vernacular Versions).

No. 5 of 1922	.. Prospectus of the Godhra Agricultural School, Godhra (in Gujarati).
No. 6 of 1922	.. Increase in the yield of Rice Crop by Mass Selection of Seed.
No. 1 of 1923	.. Saving of Seed in Rice Cultivation in Kanara.
No. 2 of 1923	.. The Sweet Potato Crop in the Konkan.
No 3 of 1923	.. Sulphate of Ammonia; Precaution in purchasing this Manure.

No. 4 of 1923	.. The Tambera Disease of Potatoes.
No. 5 of 1923	.. Smut Disease of *jowar* and wheat.
No. 6 of 1923	.. Bone Meal as a Manure for Rice in the Southern Konkan.
No. 7 of 1923	.. Common Salt for Manure.

This does not include by any means all the publication activity of the Department. Most of the material in the Vernacular agricultural magazines referred to in paragraph 23 has been supplied by the staff, and articles have also frequently been contributed to the general press by many members of the Department. Further a large number of articles have also been written for the Agricultural Journal of India based on the work done in Bombay.

III.—*Services Undertaken for the Public.*

27. Apart from the direct propaganda activities of the Agricultural Department, there are a number of services which it undertakes, which in most other countries are done by private agency, and which in future years may be undertaken here by such agency. Some of these services may be here referred to:—

28. *Seed Supply.*—The first of them is the organisation of the supply of pure seed. The present organisation of the supply of pure cotton seed is an example. The original seed is produced by our breeders and new freshly selected pure seed is provided by them in limited quantities every year. The amount is multiplied on our farms whether in Sind (Mirpurkhas), Khandesh (Jalgaon), the Southern Maratha Country (Dharwar) and Gujarat (Surat and Broach), until there is enough to sow an area say of from five hundred to two thousand acres as the case may be. This is then given out to cultivators or groups of cultivators to grow under the supervision of the department and the seed from the produce is either purchased by the department for further distribution at approximately cost price, or by co-operative or other agency under arrangements made with us. This means a large organisation, but until competent private or co-operative agency takes the matter off our hands it must continue.

I have described what is done in the case of cotton, but the same method must be followed in the case of all pure types of seed. As new pure improved types of seed are produced, a similar organisation will have to be created, of which the early stages will always have to be under our supervision. The stage when an elaborate agency is required has been reached

beyond what is needed for cotton, with wheat in Sind and with rice in the Konkan.

During the year we have imported new groundnut seed from America, as the stock under cultivation here has been getting more and more impure.

29. *Implement Depots.*—Another need, which was great a few years ago, is the establishment of depots for the sale and hire of implements, notably iron ploughs. As private and co-operative agency develops, they are gradually being closed or transferred, but we retain a considerable number notably in the Central Division.

30. *Water-finding and Boring.*—The demand for the services of the Mansfield water-finder in the trap area, to locate underground supplies of water and hence to find suitable sites for digging wells has continued. For the first time charges were made for the services of the man and machine, but the calls made for the machine have still been greater than could be attended to. Almost all the tests were made in the trap area, for which alone the machine appears to give satisfactory indications.

The second line of work is that of shallow boring. Almost all the machines belonging to the Agricultural Department have been in use, and though the work done by most of the machines is, I feel, not satisfactory, yet I hope that an improvement will be made in the current year. The administration of the boring work was taken out of the hands of the Agricultural Engineer in February last, and placed in the hands of the local Deputy Directors of Agriculture, the Agricultural Engineer remaining as technical adviser and for assistance in the case of breakdowns. Moreover, a beginning has been made in placing some of our machines under local control, our engineers simply assisting when necessary. Thus the Kaira District Local Board has taken over several of our machines under an arrangement of this character. It would be desirabe if this system could be extended, wherever we have a probability of efficient local management.

31. *Fodder Storage.*—The storage of fodder, whether *jowar kadbi* or grass on a large scale, and in some cases in a portable form, is a new thing in this country, but has always appeared to be a profitable as well as a useful operation in a country affected with famines of fodder, and hence with large changes in price from year to year. The principal work in this direction this year has been the continuance of the storage of shredded *kadbi*, in a baled condition, at Kopargaon in the Ahmednagar District,

and the result has been that in each of the recent famines considerable quantities of such *kadbi* have been available. No less than 3½ lakhs of pounds of first class fodder was supplied from the stores there during the 1920-21 famine in the Ahmednagar district. At present we have four lakhs of pounds of fodder in store there.

A scheme for the storage of large quantities of *jowar kadbi* fodder purchased and shredded at the very cheap centre of Karajgi in the Dharwar district had been partially proceeded with in 1921-22, but further progress was stopped in 1922 owing to shortness of money. The works have recently again been taken in hand, and the place will be ready in December 1923. It is hoped to store twenty-five lakhs of pounds of fodder in 1923-24.

32. *Supply of Premium Bulls.*—The supply of breeding bulls of first class type is one of the present duties of the Agricultural Department and is under the control of the Deputy Director of Agriculture for Animal Breeding. In the Gujarat tract these are derived from our own herd of *Kankraj* animals at Chharodi and in Dharwar we have now a similar supply of the Mysore breed from the newly established herd at Bankapur. In other tracts we have, as yet, to purchase the best animals that our experts can find for the purpose. The whole question of the future supply of first class bulls to cultivators have been under the consideration of the Cattle Committee appointed by Government and previously referred to. The demand for breeding bulls is practically large and insistent from the South of the Bombay Presidency.

IV.—*Agricultural Education.*

33. The Agricultural College at Poona continues to be very popular. There was a rapid increase in the number of students after 1919, which reached a climax in 1921-22, when there were 205 students in the College. This is really more than the equipment and staff of the College can cope with, and the number was reduced to 194 in 1922, and to 170 in 1923. This is probably about the number that the College is able to deal with, and an endeavour will be made to maintain this number. The demand for admission from other parts of India continues, but no properly qualified student from the Bombay Presidency has been refused admission. The present rule is to admit students from outside the Bombay Presidency only if there are vacancies after all Bombay demands are met. The short one year's course, which had been suspended in 1922-23, has been re-started

and judging by the class of men applying for admission, it promises to be very useful.

34. Dr. W. Burns has acted as Principal of the College during the year, except for one month when he was on leave, and his place was taken by Mr. B. S. Patel. During the year the services of Mr. S. L. Ajrekar, Professor of Plant Pathology, have been lent to the Educational Department.

35. The results in the University Examination in Agriculture were fairly satisfactory. Out of forty-five candidates who appeared for the degree in agriculture, thirty-eight passed. In the intermediate examination sixty-five students appeared, out of whom forty-eight passed, of whom three were placed in first class.

36. The following Agricultural Schools are now working and the number of students in each school is shown below :—

Marathi	..	Loni	49
		Jambul	25
		Dhulia	10
Kanarese	..	Devi Hosur	21
Gujarati	..	Godhra	28
		Surat	15

During the year the school in Sind was finally closed, as it was obvious that there was little demand for the type of education offered. On the other hand in response to strong local demand new schools were opened at Dhulia and Surat. At Dhulia, a local committee has been formed, which with the help of the District Local Board and the Dhulia Municipality, has undertaken to supply the whole cost of maintenance of the boys, and the school room accommodation also, if Government will furnish the staff and farm required for practice. A goodly

success, at our agricultural schools. There are now four such teachers under training at Loni, three at Jambul, three at Devi Hosur, and five at Godhra. Four teachers trained at Loni in 1922-23 have now joined the schools to which they are to be attached.

V.—*Administration and Finance.*

37. The control of the Agricultural Department has been in my hands during the whole of the year under report. Of the other principal officers of the Department, I have to note with regret the final retirement of Rao Saheb M. L. Kulkarni, who was one of the most valued of our Deputy Directors of Agriculture. His connection with the Department is of many years' standing, and whether as Superintendent of the Dharwar Farm, Divisional Superintendent of Agriculture, or Deputy Director, he has been characterised by energy in work, and by success in propaganda. I may say that the development of the system of co-operative cotton auction sale in the Karnatak, which is an essential feature in the improvement of the types grown there, is very largely due to his work. We lose in him one of our most valuable officers. Mr. P. C. Patil, Deputy Director of Agriculture, South Central Division, who had been on study leave in America, returned during the year and resumed his duties.

38. Other changes in the senior staff of the Department were as follows :—

(1) Mr. F. J. Master, my Personal Assistant, was on leave until November 1922, as the result of an accident. During his absence Mr. K. M. Pawar, Inspector of Agricultural Schools, acted in his place.

(2) Mr. K. M. Pawar was allowed to go to the Kagal (Senior) State as Land Development Officer for the early months of 1923.

(3) Mr. V. K. Kogekar, Divisional Superintendent of Agriculture, South Central Division, went on leave in September 1922 on the abolition of his post as a measure of retrenchment, with permission to retire at the close of his leave.

(4) Mr. T. Gilbert, Deputy Director of Agriculture, Southern Division, went on leave in May 1923, and his place was taken by Mr. S. S. Salimath.

39. During the year the expenditure on the Agricultural Department amounted to Rs. 14,77,950 as against Rs. 19,50,254 in the year before. The difference in expenditure is due to the fact that while in 1921-22 there was a large and sudden increase due to revision of pay, in the year under report the budget grants were cut down by Rs. 3,36,000. This has inevitably meant a very careful examination of all items of expenditure and considerable economies were made without, I think, much sacrifice of efficiency. In certain directions efficiency has suffered, particularly in connection with the maintenance of machinery, implements and the like kept for hire. But the very large reduction in expenditure has not led to the loss of efficient work that I at one time feared it would. The receipts amount to Rs. 2,96,000 as against Rs. 2,68,000 in the previous year, so that the *nett* cost of the Agricultural Department to the public revenue has gone down by just over three lakhs of rupees from that of the previous year, and hardly exceeds that of 1920-21, before revision of pay became effective, in spite of large increase in the range of activity. As regards the Personal Ledger Account of Rs. 1,50,000 for the financing of seed, manure, implement supply and the like, Rs. 1,78,345 were advanced during the year, and Rs. 1,48,295 were recovered. The larger portion of the amount was employed in financing the supply of improved cotton seed in the Surat and Broach Districts.

40. Grants were received from the Sir Sassoon David Trust Fund, just after the close of the year, amounting to Rs. 34,832. These grants were made for the following purposes :—

1. Rs. 2,500 towards the cost of five vernacular agricultural schools.
2. Rs. 15,000 towards the cost of investigation of the difficulties of potato cultivation.
3. Rs. 1,000 being a final grant towards the cost of the investigation of the deterioration of cardamoms.
4. Rs. 3,000 towards the cost of investigations regarding the eradication of certain weeds.
5. Rs. 6,666 towards the cost of investigation of drought-resisting high yielding strains of food crops, particularly *bajri*.
6. Rs. 6,666 towards the cost of investigations of the insect diseases of *jowar*.

These grants are of extreme value and have made possible several most important investigations, which could not otherwise have been undertaken.

41. In conclusion, I should like to record the hearty and unstinted work of the officers of the Department. The year was a difficult one, when expenditure had to be curtailed in many directions, but the loyalty of the men in charge of various divisions of the work has rendered it possible, in spite of this fact, for us to record a year of distinct progress towards the objects for which the Agricultural Department exists.

HAROLD H. MANN,

Director of Agriculture,

November 3rd, 1923. Bombay Presidency, Poona.

APPENDIX A.

Annual Report of the Poona Agricultural College for the year ending June 1923.

This is the fifteenth year of the existence of the College. No Bombay students have been excluded in favour of those outside the Presidency. The present rule is to admit men from outside the Presidency, only if there are vacancies left after all Bombay demands are met.

Plague started on the College estate in the third week of September 1922 and hence the College was closed at once. Several plague-infected rats were found on the estate and two deaths amongst the farm servants occurred. The opening of the second term was hence delayed till the 13th of November 1922, when sporadic plague was still going on in Poona. All the students and people on the College estate were inoculated and hence there was no further danger. Owing to the epidemic, teaching was hindered a great deal.

Staff.

Mr. J. B. Knight, M.Sc., Professor of Agriculture and Acting Principal, went on two years' leave from 16th May 1922. I worked as Acting Principal throughout the year except the month of April, when I was on leave. Mr. B. S. Patel, Professor of Agriculture, then acted as Principal.

Mr. G. B. Patwardhan, Assistant Professor of Botany, went on leave for four months from 1st June 1922 onwards. Mr. L. B. Kulkarni acted in his place.

Mr. B. N. Vakil left us on being relieved by Mr. G. S. Kulkarni, who returned from England on 1st October 1922, after completion of his studies there and resumed duty as Assistant Professor of Mycology.

Mr. S. L. Ajrekar, Plant Pathologist, left us in January 1923 to join the Educational Department as Professor of Botany, Gujarat College, Ahmedabad. He has now been transferred to the Royal College of Science, Bombay.

Messrs. D. L. Sahasrabudhe, R. S. Kasargode, J. P. Trivedi, G. S. Cheema and G. B. Patwardhan were on leave during the vacation. Their absence at this time did not interfere with the College work.

Optionals.

The Senior B.Ag. students (including Diploma students) elected optionals as follows :—

(*a*) Agricultural Economics, Land Development and Intensive Farming	37
(*b*) Advanced Botany	5
(*c*) Advanced Chemistry	4
(*d*) Stock breeding, Feeding and Management including Dairying	5
(*e*) Advanced Entomology	3

Examinations.

Of the forty-five candidates, who sat for the B.Ag. examination, thirty-eight passed.

Sixty-four students were sent up for the I.Ag. examination. Three of these passed with first class and forty-five with second class marks.

At the Final College Examination for the Diploma, five candidates were granted Diplomas. Two students appeared for the first year examination for the diploma and passed.

Students.

It has been the custom in the past to take a census of the College on June 30, that is, on the last day of the year under report and one month after the opening of the College Session. This is a convenient date, as by that time the population of the College has settled down. There are always a few changes thereafter, but for statistical purposes it would be difficult to find a more convenient date.

One would naturally conclude that when a man applies for admission to a college and sends in an admission form duly filled up, he means to attend that College. This perfectly reasonable supposition is, however, yearly falsified by our experience, and this year has created a record in the number of men who applied for admission, were formally admitted and then failed to come.

The position on June 30, 1923 was:—

Number of vacancies (in degree course) ..		75
Last year's first year failed men	16	
New admissions	99	
Total therefore admitted ..	115	
Of these the following did *not* join :		
Last year's failed men	12	
New admissions	42	
Total admitted but who did not join ..	54	
Difference between admissions and number joining	61	
Of these, after actually joining, the following left the College	8	
Total left in the Class	53	

(Of these, two men on account of special qualifications were transferred to the second year class).

By the time all information had been received from men who had been admitted and had not joined, it was too late, according to University Rules, to admit other men to take their vacant places. The University demands 70 attendances in each term.

In connection with these figures I would remark that this College is penalised by having to start so early as June 1, in order to make the most of the weather for agricultural operations. The Arts Colleges do not open till June 20 and it is not uncommon for men to come to us and then change over to the Arts Colleges when they find that they do not like our course. Such men are no loss, but the hardship lies in not being able to fill up the vacancies caused by these defections.

As to the men who never came at all, although they had signed admission forms, there is no doubt that some policy will have to be adopted whereby, without scaring away men, some money advance will be demanded as a security, to be forfeited if a candidate does not join, and without which there will be no registration. We have all along tried to avoid such advances, as they are difficult to collect and tend to prevent some men joining, but this year's experience leaves us no alternative.

There seems little doubt that some men, at least, fill up admission forms for more than one College and then at the last moment decide which they will attend. This has to be stopped. I should also mention that the majority of men who were admitted and did not join, did not take the trouble to inform me of their change of plans until they received telegrams from me. Even after this reminder several sent no reply.

Short Course.

This has been revived under a new form and a new name (Special Course). Men who wish one year's training mainly in practical agriculture with a small amount of training in all the allied sciences to enable them to grasp the principles underlying agricultural practice, are admitted to this course. Some of the work is done alongside students of other classes and some is done by themselves. For this course we admitted twelve men of whom seven failed to come. There are, therefore, now five in the class, including one Kumar from a State in Orissa.

Post Graduate Students.

Four men, graduates either of this or other Colleges, have been allowed to take up post-graduate study in special lines.

Details of all students for the last eight years appear below :—

Details of students.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.
(1) First year students ...	54	58	61	60	89	84	67	51
(2) Second year students..	23	36	39	46	50	53	65	49
(3) Third year students ..	35	23	35	38	48	49	57	61
(4) Special one-year students	..	..	..	23	12	18	..	5
(5) Post-graduate students.	3	7	2	3	4	6	5	4
Total ..	115	124	137	170	203	205	194	170

The statement below gives the localities from which our students are drawn :—

Locality.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.
Deccan and Khandesh ..	14	8	19	27	38	29	29	28
Southern Maratha Country and Konkan ..	44	50	42	49	52	53	56	46
Gujarat	29	36	36	43	40	38	34	33
Sind	9	9	7	7	6	7	2	6
Assam	1	1	1	3	1	1	1	3
Central India	3	1	3	..	4	2	2	3
Nizam's Dominions ..	4	6	6	8	7	6	4	5
South India and Ceylon ..	5	5	13	16	23	18	10	14
Burma	2	5	6	7	19	30	32	17
United Provinces ..	3	2	2	1	2	..	..	..
Berar	..	..	1	..	..	2	3	2
Bengal	..	..	1	4	7	8	6	2
Central Provinces ..	..	..		5	4	4	3	3
Nepal	..	..	..	..	..	1	1	1
Idar State	..	..	..	..	..	3	..	..
Madras	..	..	..	..	..	3	10	2
Ajmer	..	..	..	..	..	1	1	..
Udaipur	..	..	..	..	..	..	..	1
Travancore	..	..	..	..	..	..	..	1
Goa	..	..	..	..	..	..	..	3
Total ..	115	124	137	170	203	205	194	170

Classification of the students according to communities :—

——	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.
Brahmins	49	55	61	68	84	76	84	69
Marathas	4	4	6	16	20	21	21	15
Lingayats	3	2	2	1	5	10	7	4
Patidars (Gujarat) ..	4	10	13	12	7	5	4	7
Jains	..	..	..	6	4	1	2	2
Mahomedans	10	8	4	9	12	15	8	10
Parsis	15	12	7	5	5	2	3	4
Christians	1	..	..	7	16	21	20	14
Ceylon Students ..	..	..	..	6	7	2	2	..
Buddhists	..	..	..	7	9	16	17	12
Anavils (Surat) ..	..	..	..	..	..	2	3	
Others	29	33	44	33	34	34	23	33
Total ..	115	124	137	170	203	205	194	170

Further classification shows that out of 106 students from the Bombay Presidency (including Sind) 26 (or 24·5 per cent.) come from the four chief agricultural communities of the Presidency, *viz.*, Marathas, and Lingayats in the South and Patidars and Anavils in the North.

Courses.

The main course is the three years' course open to students qualified according to the rules of the Bombay University.

The Principal may also admit a few other students to the course, and the successful candidates receive the College Diploma. The total number, 43, admitted in the last eight years bears the following proportion annually to the total number in the class :—

	Per cent.
1916——12 out of 54 equal to	22·2
1917——3 out of 58 equal to	5·1
1918——8 out of 51 equal to	13·1
1919——4 out of 60 equal to	6·6
1920——7 out of 89 equal to	7·8
1921——1 out of 84 equal to	1·2
1922——2 out of 67 equal to	2·9
1923——6 out of 53 equal to	11·3

As a rule students of the Presidency proper are not admitted under these special conditions.

Scholarships.

The allotment during the last eight years is as under :—

Locality.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.
Deccan	3	3	3	5	7	4	6	4
Southern Maratha Country.	5	7	2	4	4	2	6	3
Gujarat	2	3	6	3	1	2	2	5
Konkan	3	2	1	3	3	7	1	3

Library.

The Library now numbers 12,059 volumes, out of which 271 were added in 1922-23.

Other Institutions.

The other institutions mentioned in the report of 1920-21 continue to be used for the teaching of students.

Employment Bureau.

This College functions as an employment bureau for its graduates and has been able to put graduates and employers (whether Government or private) in touch with one another and thus secure employment for several useful men. It is hoped that this side of our activities will develop.

With regard to employment of passed men in the year 1922 the following is the amended statement. Those employed in 1923 up to date are also given below :—

Total Number—44—1922.		Total Number—38—1923.	
Agricultural Department, Bombay	4	Agricultural Department, Bombay	3
Irrigation Department ..	1	Agricultural Department, C. P.	1
Private Farming ..	8	State Service	1
State Service	8	Agricultural Department, Burma	8
Agricultural Department, Madras	2	Not yet known ..	25
Educational Department..	4		
Other Bodies	3		
Not yet known ..	14		
Total ..	44	Total ..	38

College Gymkhana.

This body continues to do excellent work. In the Inter-Collegiate Athletic Meeting of last year this College carried off several trophies and was runner-up for the Championship.

After much correspondence, the restoration of the playing field to its pre-war condition is now in progress. We have to thank Mr. Garland Craig of the Y.M.C.A., for his continued permission to use as a playing field the ground acquired by this Association.

The assistance of Mr. Garland Craig and Mr. Mane, Physical Instructor of the Y.M.C.A., in Poona, is also gratefully acknowledged for their help in organising games at the College. This applies especially to volley-ball, recreative games of the physical training type, and base-ball. This year we hope to start basket-ball and medicine-ball also. The great value of these group games which give the maximum of exercise to the maximum people in the minimum of space cannot be overestimated. The men enjoy these games thoroughly. As the games require no expensive outfit they are deservedly popular with all students. Men who do not play any other games are attracted by these group games.

The following cups have been presented to the College Gymkhana for competitions since last report :—

Cup given for tug-of-war by Mr. P. G. Dani, B.Ag., Superintendent of Modi Bag, in memory of his father.

Cup for tennis singles and two cups for tennis doubles presented by H. H. the Maharaja of Porbander. This generous donor also presented Rs. 500 for the improvement of the tennis courts.

Cup for runner-up of the College Championship, presented by Mr. Shaikh Mohiyuddin, B.Ag., Deputy Collector of the Panch Mahals.

The College platoon of the University Training Corps, during the Pashan Camp of the Corps in October 1922, carried off the Inter-Platoon Shooting Shield and one of our students won the prize for Battalion shot.

A Students' Botanical Society is the latest addition to the students' organisation of the College.

College Veterinary Hospital.

During the year under report the following processes have been increasingly employed with excellent results.

(1) Drenching cattle, horses, sheep and goats, by nasal route by a single india-rubber tube.

(2) The new method of castration of the bovine male by Burdizzo's castrator.

(3) Gastro-intestinal lavage of the domestic animals with simple stomach.

The details of the working of the Public Veterinary Hospital for the year are noted below :—

Patients treated.	1920-21.	1921-22.	1922-23.	Remarks.
Total	2,045	2,419	2,714	
In-patients	515	514	400	
Patients treated on tour	162	176	69	
Out-patients	1,379	1,617	2,160	
Supplied with medicines	89	112	85	
Daily average attendance	36·49	41·57	39·25	
Do. In-patients	20·08	24·08	16·66	
Do. Out-patients	16·41	17·49	22·51	
Free patients	1,116	1,032	1,252	
Paid patients	929	1,099	1,278	
Agricultural animals	1,179	448	437	
Non-agricultural animals	866	1,603	815	
Castrations performed	69	99	63	Including caponizing.
Attendance on Rinderpest	40	10	6	
Do. Foot and Mouth ..	1	10	3	
Do. Black quarter	1	..	2	
Do. H. Septicæmia	..	1	..	
Do. on Glanders	..	1	..	
Do. on Epizootic Lymphangitis ..	..	1	..	
Do. on Fowl Cholera ..	..	1	..	
Do. on Pneumo-Pericarditis ..	..	1	..	
Inoculations performed	1,088	154	256	

(Signed) W. BURNS,
Acting Principal.

Poona Agricultural College :
Poona, July 19, 1923.

APPENDIX B.

Summary of work done under the Deputy Director of Agriculture, North Central Division, Nasik, 1922-23.

Staff and Organisation.

(1) I have continued in charge of the North Central Division throughout the year under report. My permanent staff—as mentioned in paragraph 2 of last year's report—has remained unchanged. The transfer of a large section of the Agricultural Engineer's work, including boring, has increased my staff to the extent of a Mechanical Assistant and a Boring Overseer with their respective subordinate establishment. In addition, the commencement of the Vernacular Agricultural School at Dhulia, necessitated the appointment of a Head Master and Assistant Master for that Institution.

(2) The organisation of work in the Division was fully described in last year's report and during the past year, it has not been found necessary to make any radical change in that system of administration. It is noteworthy, however, that in both the sections "district work" and "Cotton," an ever-increasing amount of assistance from local non-official bodies in the Division is being received.

(3) The Divisional Board of Agriculture, N. C. D. (Nasik and Khandesh), which was established by Government last year, held four meetings during the year under report. It is gratifying to note that there was a hundred per cent. attendance at most of these meetings, and that very real and effective service was rendered by non-official members. The objects for which the Board was instituted, namely, the closer co-operation between the Co-operative and Agricultural Departments and the consequent increased ability of both to stimulate and assist local and non-official efforts at agricultural propaganda and improvement, are in a fair way to being realised. With simplified methods of procedure and with extended publicity, the potentiality of the Divisional Board as a real help to the cultivator will be greatly increased. Two new members, to represent the cotton trade and industry, have recently been appointed and have greatly strengthened the personnel of the Board. I give here the names of the members of the Divisional Board, N. C. D.

Deputy Director of Agriculture, N. C. D. (Chairman).
Assistant Registrar, Co-operative Societies, Bombay.
Assistant Registrar, Co-operative Societies, N. D., Surat.
Mr. B. R. Ransing—Dhulia, West Khandesh.
Mr. P. M. Bildikar—Pachora, East Khandesh.
Mr. S. B. Deshmukh—Pimpalner, West Khandesh.
Mr. A. V. Patil—Satana, Nasik.
Rao Saheb Rupchand Motiram, M.L.C.—Jalgaon, East Khandesh.
Rao Saheb Gulabchand Hiralal—Dhulia, West Khandesh.

(4) A Staff Conference was held at Nasik in April and was attended by all the senior members of the Department staff in the Division. The range of subjects was very comprehensive and included many matters of

great importance to the future development of the work of the Department in the Division. A manurial scheme, co-ordinating all manurial experiments in the Division, was drawn up, Committees were appointed to deal with the publication of a Divisional Agricultural Year-Book, and to investigate the means of reducing the book-keeping and clerical work of district officers and a definite policy of implement demonstrations was arranged. Apart from the actual results of the Conference, it was decidedly valuable as a means of interchange of ideas amongst the various members of the propaganda and expert staff working in different tracts of the Division.

District Work.

(5) During the year under report, the work of the District Agricultural Overseers in each district has, more or less, been confined to one or two talukas. This has been found necessary in order to minimise touring expenses and, in addition, talukas selected were those designed to come under the Taluka Development Association Scheme. Apart from these considerations, the policy of concentration of effort has met with much success. One of the most pleasing results, in the selected areas, is to be seen in the increase of non-official local interest and effort in the direction of agricultural improvement.

(6) *Experiments and Demonstrations.*—(*a*) Khandesh.—The manurial experiments on the cotton crop, designed to meet the shortage of farm yard manure were continued, and the use of castor cake in this connection is becoming widely popularised. During the last two years, the average increase in seed cotton per acre obtained from plots manured with 400 lbs. castor cake per acre amounts to 225 lbs. over unmanured plots. Owing to the peculiar distribution of the rainfall, the effect of good tillage on the outturn of cotton was very evident both on the Farms and on the plots arranged under the supervision of the Department. A manurial experiment on the irrigated wheat crop was arranged in four centres. One hundred and fifty pounds of sodium nitrate supplied by the Chilean Nitrate Company—was applied per acre. The manured plots gave an increased yield of 508 lbs. per acre on an average over the unmanured sodium nitrate, either applied alone, or in mixture with superphosphates, gave encouraging results on the chillie crop. Further investigation is however necessary. Good results have also been obtained this year through the application of mixed manures to onions.

The introduction of Akola *bajri* in place of the local variety in West Khandesh is extending and the increase in yield of grain obtained by growing the imported variety amounts to as much as fifty per cent. Potatoes were again tried, as a new crop, in both East and West Khandesh, but the season did not prove favourable for good yields. Demonstrations were held in connection with the successful experiments mentioned above, and were well attended by the cultivators. In addition numerous single object demonstrations of ploughing, chaff cutting, etc., were conducted by our staff and by the numerous Agricultural Associations in Khandesh. Over 100 villages were visited by the District Agricultural Overseers

and the advantages of Taluka Development Associations explained to a large number of people.

(7) (*b*) *Nasik.*—Ninety-nine experimental and demonstrational plots were laid down on cultivators' fields in Nasik district.

In the Girna Canal area, the acreage under sugarcane was 530 acres, as compared with 398 acres last year. Nearly half of this area is planted according to the wide planting system advocated by the Department. On the Kadwa Canal, the acreage of cane is 326 acres and would have been much greater, if the water supply had been larger. In both canal areas the use of sulphate of ammonia and castor cake as a manure for the cane crop is a general practice. These results are the outcome of experiment and demonstration by the Department in the cane growing tracts. Improvement has also been made in the system of cane cultivation on well and bandhara irrigation. A varietal test of sugarcane is being conducted at Kokangaon, Niphad taluka and useful information is being obtained.

The introduction of Akola bajri is now established and arrangements are being made for seed supply and extension.

Owing to the deficiency of *rab* material in Igatpuri taluka, the cultivation of the rice crop has been somewhat hindered. To remedy this trial was made of a dressing of 12 lbs. sulphate of ammonia per guntha of seed bed as a *rab* substitute. The results were very satisfactory and greatly appreciated by the cultivators. As an outcome of this, 100 cultivators in the taluka adopted this innovation and used 2,200 lbs. ammonium sulphate over an area of five acres of seed beds. Very much greater extension is anticipated next year.

Through the generosity of Mr. Jategaonkar of Belgaon, Nasik District, a five-acre plot under well irrigation has been placed free of all charge at the disposal of the Agricultural Department. This will be of great utility for experimental work in the Nasik District and a cropping scheme has been drawn up and put into effect.

Five large demonstrations were held in the district and numerous small ones of ploughs, sprayers, cane crushers, etc., brought these implements to the notice of the cultivators. Two demonstrations of *gul* preparation on the Poona furnace were well attended. The lack of Agricultural Associations in Nasik District makes the arranging and carrying out of such demonstrations more difficult to organize than in Khandesh.

(8) In concluding this part of the report, I may definitely say that, during the year, much advance has been made in building up local bodies upon the efforts of whom the success of such propaganda work depends. In order to reach the great majority of cultivators and to spread abroad information and education on agricultural matters, the work of the Agricultural Department must be supplemented by the willing efforts of private gentlemen, who are interested in improving the agriculture in their neighbourhood. Many such are forthcoming but still more are needed and I feel sure that, realising the vast improvements which can be effected, this help will be freely offered.

(9) *Implement and Seed Depôts.*—The Agricultural Department maintained ten Implement Depôts at selected centres in the Division and during the year under report and the receipts for hire of ploughs and other implements totalled Rs. 1,871-1-0. Last year's total was Rs. 1,551-10-0 and,1918-19, Rs. 436-13-0, so it will be seen that much advance is being made in popularising new and improved implements amongst the cultivators. In addition, many Taluka Development Associations and Agricultural Associations in Khandesh possess a stock of implements of their own and hire ploughs, etc., out to their members at nominal rates. The officers of the Agricultural Department are always willing to give information and assistance to firms and private individuals who desire to take up this work as it is beyond dispute that the cheapest and most immediate means of agricultural improvement is to be found in thorough cultivation of the soil and good tillage, by means of improved agricultural implements. In addition, the scarcity of labour which is becoming more and more felt in the Division can only be met with the increased use of labour saving machinery.

(10) *Seed Manure and Implement Distribution.*—One of the principal services rendered to the public by the Agricultural Department consists of the supply of good seed, suitable manures and approved implements at reasonable rates to the cultivators. This branch of the work is extending very rapidly and it is pleasing to note that many private agencies are now taking part in it. In Nasik District, 232,580 lbs. of artificial manures to a value of Rs. 15,057 were distributed, with the co-operation of private agencies to the cultivators. In addition, two agencies in Malegaon Taluka have supplied agricultural material worth Rs. 12,000 to the sugarcane growers of that tract.

Excluding cotton seed, which is dealt with in a separate section, Nasik depôts supplied seeds to the value of Rs. 1,184-10-0. In the same district, the total value of implements, spares, etc., sold to cultivators amounted to Rs. 2,615-15-0, and Rs. 344-12-0, worth of insecticides, spraying materials were distributed on sale.

In Khandesh much of this work is undertaken by Development and Agricultural Associations, but over Rs. 5,000 worth of agricultural material was supplied direct by the Agricultural Department.

(11) In many places throughout the Division, the cultivators are fully aware of the advantages to be gained by the use of good guaranteed seed, artificial manures and modern implements and in such places the demand for all those is acute. The necessity for demonstration and education in this respect has disappeared and instead the main requirement is co-operative organisation to facilitate supply. This fact is not being lost sight of as will be noticed from my report on the work and growth of Taluka Development Associations and Agricultural Associations in general.

(12) *Agricultural Association work.*—In last year's report, I mentioned the new scheme approved by Government, whereby it was hoped to utilize existing Agricultural Associations and create new ones to assist

in carrying on more intensive agricultural propaganda in the district with the taluka as a unit. The scheme was explained in several selected talukas in this Division and was received with enthusiasm.

In Khandesh, at the commencement of the year, there existed eleven Agricultural Associations more or less effective. Work was concentrated in five talukas and as a result, five Taluka Agricultural Development Associations have been formed, in Pachora, Jalgaon, Dhulia, Bhusawal and Raver Talukas. All of these have been recommended for registration by the Divisional Board, N. C. D., who scrutinize the applications. In Nasik District, an association was started in Satana (Baglan) Taluka and was also recommended for registration by the Board. Two of these Development Associations, Pachora and Jalgaon, have already received subsidies from Government.

All the Development Associations—and many of the Agricultural Associations—have engaged one or more fieldmen to carry on their work. Pachora Taluka Development Association employ a agricultural graduate and two fieldmen.

(13) As a result of this, agricultural propaganda and organization have received a great impetus in the Division, and much good work has been already completed.

Pachora Taluka Development Association have loaned Rs. 13,000 to members for land improvement schemes, have conducted 70 plough demonstrations and have laid down, with the assistance of the Department, numerous demonstration and experimental plots in the taluka. This body also distributed about 3½ lakh pounds of "N.R." cotton seed to its members. As may be imagined, the Association is proving a very active force in agricultural improvement in the taluka. In Jalgaon and Dhulia Talukas, much work has been undertaken by the Taluka Development Associations and their reports give very encouraging results.

Bhusawal and Raver Taluka Development Associations are of more recent origin, but they also have taken a large part in the propaganda for agricultural improvement in their respective areas. At a very nominal rate of hire, the abovementioned associations have collected almost Rs. 550 on account of plough hire among their members and have distributed on sale quantities of seed and manure.

The Agricultural Associations in other talukas have also contributed their share to the agricultural development of the Division and it is hoped will soon be able to assume the wider responsibilities and increased effectiveness of Taluka Development Associations.

(14) I may be permitted to mention here the necessity for enthusiasm and practical interest in the affairs of these Taluka Development Associations on the part of the officials and leading cultivators of the taluka. While Government is anxious and willing to act as god-father to these bodies, wherever and whenever they come into existence, it must not be forgotten that the real parental responsibility for their up-bringing and development rests with the local Managing Committee in charge of them.

(15) A very successful Conference of Taluka Development Associations was held at Pachora in June. Most of these bodies in the Division were represented and many matters of common interest discussed. It is hoped to make this meeting an annual one.

(16) *Special work*—(a) *Power Cane Crushing Plant at Sukene.*—At the request of Mr. Kondaji Patil of Sukene, the Department arranged the erection of a power cane crushing plant on his estate. The cost of preparing gul by the plant amounted to Rs. 3-5-4 per palla as compared with Rs. 4-5-0 per palla by the cattle-driven mill. Poona furnaces were also constructed. 812 pallas of gul were prepared and the quality was very good.

(b) *Demonstration Silo at Belgaum.*—This was again filled by the owner, 26,400 lbs. grass being put in at a cost of Rs. 92. 14,520 lbs. of ensilage was obtained.

(c) *Insect pests and Fungoid diseases.*—In addition to the supply of materials to combat insect pests and fungoid diseases, the district officers gave help and advice on this subject to many cultivators. Much trouble was reported on the wheat crop by rats and poisoning was undertaken.

(d) *Trial of Implements.*—Numerous trials of ploughs, etc., were conducted under varying conditions of soil, etc., in the district and reports submitted.

(e) *Miscellaneous work.*—The staff contributed many articles of agricultural interest to various magazines and newspapers.

Farm Section.

(17) In view of the fact that the claims of economy demand a certain amount of curtailment of this report, I do not propose to give a detailed account of the work which has been carried on during the past year on the Government Farms in my charge.

In accordance with the avowed policy of the Department, the experimental and demonstrational work, which used to form a large portion of the annual programme of the Farms, has now been transferred, under local and non-official direction, to the fields of the cultivators themselves. As a result, the Farms,—with certain definite exceptions—are utilized as centres, on which the work in the district is based. Their success will be judged, within limits, on the efficiency of their organisation and management as commercial concerns.

(18) *Jalgaon Farm.*—The principal object which Jalgaon Farm fulfils in the work of the Agricultural Department in this Division is the production of pure N. R. Cotton seed for distribution to registered seed growers, seed societies, Agricultural Development Associations, etc., and consequent extension in the district. In addition, the farm grows various other rotation crops on commercial lines, tests and reports on new implements and machinery, and conducts investigations into new systems of economic management, manuring, tillage, etc., before these are introduced into the districts.

Cotton crop.—During the year under report the sowing of the cotton crop was extremely late and was not completed till the 5th July. In this month, heavy rains hindred intercultural operations but every advantage was taken of fair intervals. A prolonged drought in August was not so damaging as might have been expected owing to careful tillage and the crop gave promise of a very good yield. However heavy rains in the middle of September, when the crop was in an advanced stage of growth, caused damage estimated at 25 per cent. of the outturn. Also more rain during November when the first picking was in progress, damaged the colour of the lint and caused irregular opening of the bolls. A good deal of loss was also caused by boll-worm but the effect of wilt disease was less than usual.

On the whole, the season, due to the peculiar distribution of the rainfall, was not a favourable one for the crop. The average yield per acre amounted to 485 lbs. seed cotton as compared with 666 lbs. in 1921-22. The total outturn of lint, amounting to 66 pallas, was sold by auction for Rs. 7,693-13-6.

As compared with 32,000 lbs. in 1921-22, the Farm supplied 25,708 lbs. of first class "N.R." seed to the Cotton Supervisor, for distribution this year.

Other crops.—The *kharif* crops of *jowar*, groundnut and *udid*, in spite of the vagaries of the season, did extremely well.

Fourteen acres of groundnut yielded an average outturn of dry pods per acre of 1,876 lbs., the average for the last five years being 1,198 lbs.

The *jowar* crop occupied 24 acres 19 gunthas and gave an average yield of 1,199 lbs. grain and 2,546 lbs. *kadbi* per acre. A six-acre block of the "Aispuri" *jowar* variety yielded per acre 1,647 lbs. of grain and 3,040 lbs. *kadbi*. This is a record for that crop on the farm.

The chief *rabi* crops, wheat, gram and coriander occupied acreages of 19 acres 17 gunthas, 3 acres 28 gunthas and 3 acres 29 gunthas respectively. The wheat crop was excellent and the average yield per acre of 1,247 lbs. grain and 1,644 lbs. *bhusa* was most satisfactory. On a four and half acre plot, the record yield for the farm of 1,448 lbs. grain was obtained. The gram crop followed maize and *sundhia* taken as a fodder crop in the *kharif* season. An excellent average yield of 938 lbs. gram per acre was harvested. Coriander yielded 539 lbs. average per acre.

Implement Depôt.—The farm implement depôt has fully maintained its popularity with the cultivators of East Khandesh District, and the stock available for hire cannot meet the demands. Twenty ploughs, including fourteen placed on the farm by Rao Saheb Rupchand Motiram, M.L.C., realised in hire charges up to the end of June, Rs. 657-2-0. In 1918-19 the receipts on this account were only Rs. 20-11-0 and last year Rs. 453-15-0 were taken.

Much of the credit for this work is due to the district workers who introduced these implements to the cultivators and who create the demand it is being found so difficult to satisfy. It is not easily understood why the makers and agents of agricultural implements, especially iron ploughs, neglect the opportunity of direct financial profit and advertisement which would undoubtedly result by their establishing such depôts in suitable centres in the districts. In addition to hire receipts, the Farm Depôts sold implements and spare parts valued at Rs. 4,570-1-3.

Trial of Implements, Machinery, etc.—For the third year in succession, the Wiard plough No. 124 was tested for uprooting groundnut and the results obtained confirm the previous opinion that it has no advantage over picking by hand. A winnowing machine constructed by Mr. G. V. Mistri of Dhulia was tested on the Farm and certain defects pointed out to the maker, who is having the necessary alterations made. When these are completed, the Winnower should prove useful in the districts. Several ploughs were put to a practical test on the Farm and reports and suggestions forwarded to the manufacturers.

Experimental Work.—Under this heading, may be included the manurial experiments conducted on the various crops of the farm. The trials of mahua cake *versus* castor cake as a manure for cotton have not yet reached a definite conclusion. Top-dressing with nitrate of soda on patches of the cotton crop where wilt disease appeared had no obvious results, but the experiment will be continued this year with varying quantities of the manure.

Miscellaneous.—The usual Farm Demonstration was held in October and was well attended. Over 600 visitors visited the Farm during the year under report. A scheme has been recently submitted to, and approved by, Government, whereby a post-graduate apprentice course in Farm Management will be commenced on Jalgaon Farm. About twenty requests for information as to the curriculum, prospects of employment after training etc., have been received, and it is anticipated that a selection of students for training will be made soon.

(19) *Dhulia Farm.*—Since the appointment of a Cotton Breeder for Khandesh and the opening of a Vernacular Agricultural School at Dhulia, the function of Dhulia farm has been changed and it is now intended to supply the following three requirements :—

(1) Experimental station for the Cotton Breeder, Khandesh, for his scientific work on cotton or any other crop.

(2) Area for the first stage multiplication of improved types of cotton produced by the Cotton Breeder.

(3) Farm for practical training of boys attending Dhulia Vernacular Agricultural School.

The first of these has already been established and in a short time it is hoped that the work of the Cotton Breeder will be sufficiently far advanced to enable the work foreshadowed in the second requirement to be undertaken.

A commencement has also been made to utilise the Farm for the practice of the scholars attending Dhulia School and this function of the Farm is in course of being greatly developed. This report therefore will probably be the last dealing with Dhulia Farm in the accepted sense of a Government Farm and in future it will assume the dual role of a scientific station and an educational institution.

Crops.—The cotton crop occupied 7½ acres of the farm area, exclusive of the plot reserved for the Cotton Breeder.

As on Jalgaon Farm, improved tillage minimised the evil effects of the long drought in August and an average yield of 1,130 lbs. seed cotton per acre was obtained. This compares favourably with an average outturn per acre of 726 lbs. per acre last year. The lint fetched Rs. 120—126 per palla when disposed of.

Bajri (Akola) yielded 1,377 lbs. grain per acre. The drought affected the yields of the *til* and groundnut crops which were considerably lower than last year.

The farm orchard was continued during the year but it becomes more and more obvious that the situation and soil are not suited to successful fruit culture. Grape vines, figs, mangoes, and guavas were replaced by Mozambique oranges.

A number of Jamburi seedlings were raised and will be ready for budding next year.

In view of the fact that Rao Saheb Gulabchand Hiralal has offered suitable ground for a nursery near Dhulia, this type of work will be carried on there in future.

The *tarward* plots did not show strong growth and only one of them unpruned and manured with farm yard manure—was harvested. Seven and a half tolas of bark per plant was obtained.

Implement Depôt.—The total amount received by sale of spare parts, etc., amounted to Rs. 1,795-9-0. Eighty-two iron mhots were supplied to surrounding cultivators.

Visitors.—There were many visitors to the Farm during the year. The Honourable Mr. C. V. Mehta, Minister for Agriculture, paid a visit to the Farm in January 1923.

Cotton Breeding Work.

(20) The Cotton Breeder, Khandesh, continued his detailed study of these cotton types known hitherto as Bani-Comilla crosses which showed such promise last year. The object of his work was to determine the differentiating characters in each apparently pure strain of the hybrid plants and also to ascertain the gametic purity of the plants selected last year. Notes were taken on various botanical characters and on yield, ginning percentage and staple. As a result of this study, encouraging results have been obtained and the following note by the Secretary, Indian Cotton Committee, on samples submitted has been received.

"B XI 9 is much the best in staple and compares with Bardoli-Navsari cotton. B IV 50 is about equal to Dholleras. B XX 1 is rather better than B IV 50 and is second on the list. The above three cottons are staple cottons."

"B XX 27 is much shorter than the preceding three and is more of the Oomras style but is still a nice soft cotton."

The strains of this cross have been reserved for future trials.

Six strains of "N.R." cotton, grown on Dhulia Farm, have been isolated and it is intended to make a detailed study of such of these as show extreme variation of a desirable nature. Also four strains of the constituents of the Khandesh cotton mixture known as "N.V." and two strains of that known as "N.V.M." are being further studied.

The future line of work lies in rigid selection and purification of the Bani Comilla crosses now available and the study of extreme variations of a desirable nature in *Neglectum* cottons, with a view to future crossing, if found necessary.

Some of the cottons, mentioned above, are being tried in the district on a small scale during the coming year in order to ascertain how they maintain their vigour of growth, etc., under different conditions of soil and rainfall.

District Cotton Work.

(21) The continued demand from Khandesh cotton growers for pure "N.R." seed has in no way diminished during the past year. On the other hand, owing to the adverse season, the supply available for distribution was considerably reduced.

First class seed.—During the year under report, the Jalgaon and Dhulia Farms together produced 27,500 lbs. of pure "N.R." seed for distribution. This is nearly 10,000 lbs. less than the production last year.

This first class seed was distributed to registered seed growers in Khandesh and Nasik (12,230 lbs.), Taluka Development Associations (9,400 lbs.), Registered seed growers of credit societies affiliated to Parola Guaranteeing Union (3,200 lbs.), and others (2,670 lbs.). It is gratifying to note that four Taluka Development Associations, as compared with two last year, have appointed their own registered seed growers and obtained first class seed from the farms.

The total amount of first class seed distributed is sufficient for 1,720 acres and, given a normal season, should provide second class seed for an area of about 30,000 acres next year.

Second class seed.—Last year first class seed sufficient for 1,531 acres was distributed to registered seed growers, seed unions and agricultural associations. During the present year, these agencies have produced 419,700 lbs. of second class seed for distribution sufficient for 26,230 acres. As a rule the Department engage to purchase all the seed grown by the registered seed growers but, as the grants for this purpose were inadequate, only 89,841 lbs. were purchased, stored, and resold. An equal

amount was disposed of through the agency of the Department acting as agent between the seed grower and purchaser and the remaining amount distributed by the seed growers direct. The seed unions and the agricultural associations disposed of their seed to their own members.

In the distribution of the second class seed, the policy of preferring to deal with co-operative bodies, such as agricultural associations, seed societies, co-operative credit societies, etc., has been adhered to. In this way, the further extension is facilitated.

In the past, the whole burden of the distribution and extension of N.R. seed has rested with the Agricultural Department and it has been found quite impossible on account of limited funds, etc., to make satisfactory progress. During the year under report an arrangement has been come to with the Dhulia Branch of the Co-operative Bank, whereby the Bank will purchase all the second-class seed produced by the registered seed growers of the department in West Khandesh, and distribute to its client co-operative bodies. The Bank also have under consideration a proposal made to them by me, that they should finance the purification and roguing of all or part of the cotton area grown by the institutions to whom they supply second class seed next year. The charges incurred would be recouped at the time of sale. Hitherto the Agricultural Department have been unable to control purity beyond the second generation, owing to lack of funds and staff. If the Bank accepts this proposal and it is found to work successfully, purity up to the third generation can be attained through the agency of similar co-operative institutions. This will mean a great advance in the extension of pure "N.R." cotton seed in Khandesh.

(22) In Navapur Taluka of West Khandesh district, Surat Selection No. 1 has given better returns than the local cotton. During the year, the Cotton Superintendent, Surat, has supplied 160,000 lbs. of selected seed to cultivators in this tract. Surat Selection No. 1 is also being extended into the western portion of Nandurbar taluka.

General.

(23) *Agricultural Education.*—During the year under report the proposal for the establishment of a Vernacular Agricultural School at Dhulia, made by West Khandesh Agricultural Association, was accepted by Government, and the school was opened by the Honourable Mr. C. V. Mehta, Minister for Agriculture, in January 1923.

Class room accommodation is provided free of charge in the King Edward Technical School, Dhulia, and practical training is given on the Dhulia Farm. A local committee was appointed to manage the board and lodging of the pupils and to collect subscriptions to defray these expenses from public bodies in the Division. The course of instruction covers two years and is largely practical.

As this is the first school of its type in the Division, initial difficulties have been met with but with increased experience, and, in particular with greater support from local bodies, agricultural associations, etc., the

school ought to make much progress next year. Increased facilities for practical training are being arranged and the type of education given should appeal strongly to the cultivating classes for whose benefit the school is maintained.

(24) *Boring work.*—It is too early to report intensively on this branch of the departmental work which has hitherto been in the charge of the Agricultural Engineer and was handed over to the Deputy Directors of Agriculture in February 1923.

Three machines have been allotted to this Division but, judging from the applications for bores received, this number should be considerably increased. Work done in the period under reports consisted of organising stores of tools, plant, etc., and in addition the following actual bores were made :—

Nasik District .. (1 Machine)—Five bores—Four successful and one incomplete.

Khandesh .. (2 Machines)—Two bores—both unsuccessful.

In Khandesh, the lack of success was due to the unfortunate breakdowns and to the great difficulty of obtaining cooly labour which caused much delay. It is essential that a set of fishing tools be supplied to this Division to enable the work to proceed without long and unavoidable stoppages. The three machines in the Division worked 96 days and bored 422 feet in all.

(25) The Mechanical Assistant, attached to this Division, commenced work in February 1923. He completed the erection of the cane crushing plant at Sukene and surveyed and reported on numerous river sites for the installation of pumping plants. In addition he paid visits to the Farms and attended to overhauls, repairs, etc., of machinery there.

(26) In conclusion, I would like to express my opinion that the work of agricultural improvement in this Division, has, during the past year, made much progress. The institution of the Divisional Board and the formation of Taluka Development Associations have aroused considerable local interest. The chief difficulty to be faced is lack of funds wherewith to extend work already in progress and to commence new operations. This difficulty may be minimised by co-operative effort and the Agricultural Department is paying particular attention to fostering such enterprises wherever the opportunity arises.

W. J. JENKINS,

Deputy Director of Agriculture,
North Central Division, Nasik.

APPENDIX C.

Summary of work done under the Deputy Director of Agriculture, South Central Division, Poona, for the year 1922-23.

Staff and Organisation.

1. Rao Saheb M. L. Kulkarni continued acting as Deputy Director of Agriculture until the 1st of November 1922, and I resumed duty after my long absence on study leave in America, Japan and Java. There was no important change in the personnel since the last Annual Report was submitted.

Sugarcane.

2. *Situation of sugarcane industry.*—The sugarcane industry of the province (most of the cane is grown in the divisions for which I am responsible) is hit very hard. It was not unexpected ; but due to the lack of experience and for want of timely warning the result was unavoidable. Moreover, in a country in which 90 per cent. of the population cannot read, people will not mind certain warnings. The Department of Agriculture has recently been insisting on diversification of crops on canals and on economic instead of excessive doses of manure without attracting much attention. On the other hand, a storm of criticism was raised especially on the question of using the moderate doses of concentrated manure to cane crop which we recommend.

The high prices of gul during the boom time permit the cane grower to apply heavy and costly doses of manure and to spend more on rent and labour. The boom also helped to increase the area, under cane on the canals from 15,210 acres in 1912-13 to 22,515 acres in 1920-21. The prices of gul rose between 1913-14 and 1921-22 from Rs. 17 or 18 to Rs. 40 and 45 per palla. Such a phenomenal rise has not occured within the memory of man. The cultivators therefore went on with the increased expenses in anticipation of increased returns. The increased returns during the war and afterwards could be got only on account of the disturbed agricultural economy and the expectation of its continuance was not justified. The prices kept high up to July 1922 when they began to drop and went down to Rs. 20 per palla in the harvest season of the year under report (November 1922 and onwards). With the increased cost of cultivation it does not seem possible for the cultivator to make any labour income, much less any profit—if the prices go below Rs. 25 per palla. As a result of this, the cane farmer, especially on the canals, lost on the business during the year under report.

This has made the economic position acute and many have realized that it is not only the heaviest yield that controls profit, and that he has to revise his schemes according to circumstances. Many farmers have accordingly reduced the heavy doses of concentrated manures and are

now listening to the suggestions which are calculated to save labour and economise expenses.

3. *Propaganda work in Cane tracts.*—Through the Divisional Superintendent of Agriculture, Deccan Canals and his assistants, propaganda as well as experimental work was continued. The following is the short summary of the results :—

(*a*) *Deep Cultivation.*—For this work gallows and cockshut ploughs are found very useful. The depots of the Agricultural Department have stocked these ploughs. Some of the farmers have purchased these, but almost all now use some kind of turn wrest plough for opening their lands. In a test specially conducted the following results have been obtained :—

(*a*) Gallows plough 8,200 lbs. of *gul* per acre.

(*b*) C. T. plough 7,040 lbs. of *gul* per acre.

(*b*) *Wide Planting.*—Our recommendation is that cane should be planted at least three to four feet apart with a reduced seed rate (9,000 to 11,000 sets per acre). In most of the demonstration plots wide planting has given more *gul* than the check or local method plots.

(*c*) A *ridger* for making furrows (for wide planting) is coming fast in use. Through Messrs. Kirloskar Brothers a suitable ridger has been devised and supplied to the farmers.

(*d*) *Power crushing and improved furnaces.*—The work of the power crusher is demonstrated during the last five or six years, as a result of which over seventeen crushers are in use, by now, on the Godavari, Pravara and Nira Canals. The Mutha tract has so far three such crushers. As a result of our demonstration at Mr. Wadkar's farm near Poona, a demand for small power crusher is likely to increase. All those cultivators who own power crushers have adopted the multiple furnace which has been perfected by the undersigned with the help of Manjri Farm staff before some years.

(*e*) Use of Sulphate of Ammonia has become common now. The distribution of this manure at concession rates (in the year 1920-21) through the generosity of the Sir David Sassoon Fund is largely responsible for this rapid introduction.

(*f*) In the trial of selected and unselected sets the following outturns are got :—

Selected sets :— 9,520 lbs. *gul* per acre.

Unselected sets :— 8,200 lbs. *gul* per acre.

The increase is substantial and corroborates the view of the Java Planter who is very careful about his sets.

(*g*) *Study of Soil Conditions and Varieties of Sugarcane.*—"*Manjav*" and "Red Mauritius" varieties have been found to do better in water logged lands than the ordinary "Pundia." It may

be noted that the good outturn of "Pundia" shown in the following table in a water logged area is due to the treatment advocated by the Department, *viz.*, light and occasional watering. It may further be noted that Pundia has given a larger number of canes though not as much *gul*. It is, therefore, likely that if a higher seed rate is given for Manjav, the yield of it may still be increased.

Trials to determine this will be undertaken.

Variety.	No. of canes.	Weight of canes in lbs.	Weight of Gul in lbs.	Remarks.
Manjav	22,400	112,400	12,240	In summer water level was within 1½ feet.
Pundia	24,600	106,600	12,000	

On good and dry lands (with the same seed rates) Pundia has been found to beat "Manjav." It is to be seen if a larger seed rate will help Manjav since the latter does not tiller much. It is found that Manjav does better than any other cane to fill in gaps as it is vigorous and makes up the growth rapidly.

A very interesting experiment was made by Mr. M. R. Uplekar of Baramati, in which he planted in July 1921 transplants of Pundia cane, in pits five feet apart. The soil was shallow and light, and the field being situated low received sub-soil percolation from the surrounding cane fields and from the canal. The crop had received per acre 30 cart-loads of Farm Yard Manure, 200 lbs. of Sulphate of Ammonia and 20 pallas of oil-cake. In the beginning the crop looked bushy and meagre, but it improved wonderfully after the rains of 1922. The average number of canes in each pit was 18 and the maximum 31. The crop stood for 18 months and was harvested in January 1923. The total weight of cane per acre was 83,998 lbs.

Manjri Farm.

4. This station was for many years under the control of the Professor of Agriculture but after the departure of Prof. J. B. Knight, M. Sc., on leave in May 1922, it was brought under the Deputy Director of Agriculture, S. C. D., Poona.

The work of the farm mainly consists of the study of manure and water requirements, cultural treatment, and trial of promising varieties of sugarcane. A separate report describing the experiments and interpreting results will be issued and hence important inferences only are recorded in this summary:—

(*a*) The manurial experiments of previous years were continued. The phosphatic and potash manures even when given in adequate quantities (applied to the land before

sowing the preceeding green manure crops of *sann*) again failed to show any advantage. The experiment has been repeated three times, and only once the complete manure gave higher tonnage. This is striking when it is noted that no farmyard manure or any oil-cakes or fish were applied to supply organic matter and nitrogen, but only *sann* green manure, with Sulphate of Ammonia as the only nitrogenous top-dressing.

(*b*) *Gurhal* ash with its high potash content did however give promising results when oil-cake and fish were avoided, and only sulphate of ammonia was used as the top-dressing, and when *sann* green manure formed the only bulky manure used. This shows that if Sulphate of Ammonia be had cheaper per unit of Nitrogen than oil-cakes and fish, the farmer may advantageously apply *gurhal* ashes to the previous *kharif* crop. The three years' results show, on an average, an increase in the outturn of cane by as much as twenty per cent.

(*c*) Experiments to see if the quantities of concentrated manure can be reduced below 150 lbs. of Nitrogen per acre, showed that by reduction from 150 lbs. Nitrogen to 100 lbs. Nitrogen per acre, a fall of as much as seven tons of cane per acre results in normal years like the one under report. A reduction up to 125 lbs. Nitrogen showed no decrease in outturn. The yield obtained in the cases of 150 lbs. and 125 lbs. Nitrogen was about the same, *i.e.*, 44·5 tons per acre, while the 100 lbs. Nitrogen plot gave only 37·5 tons. The results indicate the necessity of caution in reducing manurial dressings. In the case of Baramati farm, tonnage and also the net profit have increased as the dose of Nitrogen in the top-dressing increased from 150, 200 and 250 lbs.

(*d*) When trash is ploughed in as bulky manure, and if in the absence of late rains, the land is not watered after burying the trash, the cane crop grown on the land does not thrive well. This was clearly proved during the year, with a yield of only 25 tons of cane for this treatment as against the general average of about 40 tons per acre for Pundia cane on the farm. If trash is to be used, it should either be first rotted in a pit or the land given one irrigation after burying in the trash. In the case of farm yard manure tried at Baramati the tonnage increased with the increased dose but financially it did not pay.

(*e*) *Reduction of seed rate.*—It seems possible to reduce the seed rate even upto 4,500 sets per acre with Pundia cane, provided great care is taken in selection and planting of sets as well as after-care and timely irrigation, etc. Early planting is essential to avoid the attacks of borer. The tonnage obtained in the

case of the 8,000, 6000, and 4,500 sets was 43·5, 45·3 and 47 tons respectively.

(*f*) *Irrigation experiments.*—Irrigation experiments were planned to find out if cane is benefitted by irrigating it after it was earthed up, (*a*) on both sides of the cane row, or (*b*) on only one side and (*c*) whether it should be irrigated every turn (*i. e.*, once every ten days or every alternate turn, *i. e.*, (once in 20 days). The results are strongly in favour of irrigating cane, after earthing up, once every 10 days and on both sides (as is normally done). By increasing the interval to 20 days a loss was about 5 tons of cane per acre and by irrigating it on only one side the loss was 4·3 tons. The falls in yield are clearly due to reduced quantities of water applied.

A comparison of the water requirements of cane planted, according to the Manjri Method and the local method, showed that in the early stage of the crop, up to earthing up and at a time when the supply in the lake is limited, the former method required 24·36 acre inches. For the whole period of growth (12½ months) the Manjri method took 67·4 acre inches of water whereas the local method used up 75·61 acre inches (excluding 27·37 inches of rainfall in both cases). The experiment was carried for four years; two years being in favour of Manjri method and two in favour of local method. On the whole it can be said that if water can be controlled and given when required, about 12 per cent. of the water can be saved without detriment to the crop.

(*g*) *Adsalya planting.*—Experience at Manjri corroborated by a trial by Mr. Upalekar at Baramati shows that if the whole of the area proposed could not be planted in time (say by February) the planting of the remaining area may better be delayed till the end of May and planted then as Adsalya to be crushed in November. Such a crop gets the advantages of two monsoons and gives heavy tonnage and generally better prices. One has however to note that a cultivator cannot accomplish planting of large areas of such crop, that he has to pay water charges for two years, and in the case land under the block system, his area is proportionately reduced. The heavy tonnage, better market and possibilities of spreading work, however, show opening for such modification of *Adsalya* cane.

(*h*) *Trials of varieties.*—Amongst the early soft thick canes, "Red Sport", "D 109" and "Striped Mauritius" have continued to give good results. The first two look similar and have given 46·4 and 42·3 tons of cane respectively. The *gul* turned out was also hard and nice coloured.

Of the varieties tried since 1920 "White Transparent", "Waxy Red", "Java 100", "B 1528", "D 74" and "D 95" are very promising. These ripen in 11¼ to 11½ months.

Regarding hard canes some of the Coimbatore crosses might with advantage replace "Khadya" in the western parts of the Nasik District and in the Kolhapur State.

As regards the late (thick) canes last year's results at Kopargaon show that "Green Mauritius" and "Red Mauritius" which are said to rise in purity and tonnage till they are fifteen months old in their mother country, do not show increased purity. The tonnage increased but the cane gets very hard and the quality of *gul* suffers especially after the cane is fifteen months old.

Baramati Farm.

5. The study of water requirements (both as regards interval and quantity) and economic quantities of manure for cane is continued. It is found that in the Nira tract eight days' interval is advantageous in the early months of the cane crop, and that if the interval exceeds ten days there is a very material reduction in the yield. As regards actual quantity of water supplied, the yield increased with increased water up to an amount of 1·25 acre inches per annum, in addition to rainfall, when regular ten-day waterings were given. As regards manuring trials it is found that in the standard method the outturn and profit increase with the increase of nitrogen in top-dressing, while an increased quantity of farm yard manure with heavy doses of cakes in the local method has not given increased outturn. In the latter case, however, there are necessarily several variants, but it can be said that the practices (such as wide planting lower seed rate, and use of sulphate of ammonia with cake) in the standard method must have advantage over the local practice of close and thick planting and want of quick acting manures. In any case the standard method of cultivation developed at Manjri, has given a profit of nearly double that obtained by the local method at Baramati, on an equal outturn of cane the actual profits per acre being Rs. 534 in the former and Rs. 276 in the latter case.

Kopergoan Farm.

6. There are two sections of this farm namely (1) the fodder section which occupies 107 acres, and (2) the sugarcane section which occupies about 5 acres.

Fodder is raised and stored to help the farmer in times of scarcity and in that way the farm is serving a useful purpose. To grow fodder for storage in the heart of the sugarcane tract, where labour and manure is scarce, and water is costly, can hardly, however, be a paying proposition. The season for fodder growing was not favourable and the outturns per acre, in different seasons, were below normal, being about 3,894 lbs. of *kharif* and 2,724 lbs. of *rabi* fodder per acre.

Sugarcane.—The section is run more as demonstration and the outturn was good being 10,722 lbs. of *gul* per acre. Seven different varieties of

sugarcane were tried, "Red Sports" and "Manjav" stood first and second respectively. Last year "Manjav" was first. Further the local method of cultivation was compared with the standard and modified West Indies methods. The standard method plot gave 12,086 lbs. of *gul* per acre against 10,086 and 11,124 lbs. for the local and the modified West Indies methods respectively. Nitrate of soda with safflower cake has given better results as a top-dressing than sulphate of ammonia with safflower cake but this result is not in accordance with experience elsewhere in the Deccan. The trial will be repeated.

Agricultural Organisation.

7. *Divisional Board.*—This is the first year of the organisation of the Divisional Board, and its work being systematized. The following members constitute the Board:—

P. C. Patil, Esq., L.Ag., M.Sc., Deputy Director of Agriculture, Chairman.

N. P. Bhagwat, Esq., M.A., LL.B., Assistant Registrar, Co-operative Societies, C. D., Poona.

B. V. Jadhav, Esq., M.A., LL.B., M.L.C.
R. M. Sane, Esq. .. } Members nominated to represent Co-operative Societies.

Rao Bahadur G. K. Chitale, B.A., LL.B. M.L.C.
V. N. Mutalik, B.A., LL.B. .. } Members nominated to represent agricultural interest.

Four meetings were held and a good deal of business was transacted apart from the informal but useful discussions held. Apart from the meetings, considerable business was done by circulation of cases. The members have shown a fair amount of interest and it is hoped that they will do more in the coming years. The creation of this Board has added considerably to the administrative and office work of the Deputy Director of Agriculture and unless all the non-official members show more interest and make use of the Board, the advantages will not be commensurate with the trouble involved. Among other work the Board considered the constitutions of the Khed and Satara Taluka Associations and recommended a Government subsidy. Further it considered six applications for the registration of non-credit societies. Of these the Gul Sale Society for Poona tract, Potato Sale Society for Khed tract, Jowar Sale Society for Madha tract were prominent. Besides, there were some implement societies before the Board for consideration.

Taluka Development Associations.

8. (*a*) *Madha Taluka Agricultural Development Association.*—This was organised in March 1922. Membership during the year was 81. Out of the 38 Co-operative Societies in the taluka, 21 have joined the

Association. Government have given a subsidy of Rs. 1,000. During the year the Association held forty-five meetings in different villages of the taluka which were well-attended. At these meetings questions of agricultural interest were discussed and agricultural literature was read and explained. In addition to this, the Association tried to centre its activities on the following :—

(1) Advantages of "Tals" in improving lands and conserving moisture.
(2) Advantages of thin sowing in tracts like Madha where rainfall is very limited.
(3) Dusting of chillies against Mirya disease and use of copper sulphate against smut of jowar.
(4) Advantages of manuring sugarcane with cake and sulphate of ammonia.

The Association stocked "*N. R.*" cotton seed and seeds of several kinds of vegetables and distributed among its members.

The Association is making good use of the Boring plant that is lent to the Madha Taluka Local Board.

The credit of the successful working of the Association is due to Mr. Bhutkar, the Agricultural Overseer lent by the Department and also to the President, Secretary and others closely connected with it. A passed Loni student is taken under training at the expenses of the Association who will soon relieve Mr. Bhutkar.

(*b*) *Khed Taluka Agricultural Development Association.*—This was organised in October 1922 and has at present about 247 members. Some of the Credit Societies also have joined the Association. An amount of Rs. 2,604-12-0 which was collected from the cultivation in Khed Taluka some years ago for holding an exhibition has been made over to the Association, and the Government subsidy has been paid. During the year the managing committee held ten meetings and 86 resolutions concerning the conduct of the Association were passed. The activities of the Association were centred on the following things :—

(1) Formation of a Potato Sale Society : The work is progressing.
(2) Distribution of manure of potato and onions.
(3) Spraying the Potato crop against the *Mawa* and Tambera diseases.

In addition to the above, Mr. Gaikwad, the fieldman lent by the Agricultural Dpartment, has brought to the notice of the cultivators several other matters pertaining to agriculture in his field talks. A passed Loni student is taken under training who will relieve Mr. Gaikwad.

(*c*) *Satara Taluka Agricultural Development Association.*—This was started in July 1922 and has 145 members for the present. The services of a trained fieldman from this Department have been lent to the Association for carrying on the propaganda in the taluka. Khan Bahadur Cooper, the President, is getting people interested. The activities of

the Association during the year under report were directed on the following main points among many others :—

(1) Meetings were held at several villages and the advantages of the Association and of agricultural improvements were explained.

(2) Implement demonstrations were given in several villages.

(3) Freshly imported spanish peanut groundnut seed, as also Akola Bajri seed is distributed to the members.

(4) The fieldman of the Association is bringing the value of methods of moisture preservation in soil to the notice of the members.

Preliminary work in starting a development association for Walva Taluka in Satara District is in hand.

9. *Co-operative Sale Societies.*—This work though very important has not made much progress in the past. Important though this work is, it is surrounded by so many local difficulties. With the help of the new assistant (the Agricultural Organiser) placed at the disposal of the Deputy Director of Agriculture, the situation of important industries is being studied and work of three pioneer societies, in three different staples, taken in hand and preliminaries carried out. The applications of these societies are sent for registration—

(*a*) Gul Sale Society for Poona tract.

(*b*) Potato Sale Society for Khed tract.

(*c*) Jowar Sale Society for Madha and Mohol tract.

10. *Irrigation Societies*—(a) *Irrigators' Associations*.—The Irrigators' Associations for the Nira and Godavari Canals have maintained their activities. The Ekruk Tank Bagayatdars' Sangh has been started this year. These associations are formed by the Irrigators to ventilate their grievances.

(b) *Kolhar Irrigation Society*.—An Irrigators' Association is formed at Kolhar which is managing a distributary irrigating 93 acres of cane and 613 of other crops. It is carrying several other useful activities and is found very useful in pushing certain improvements in sugarcane cultivation.

(c) *Nangaon Pumping Society.*—Another society at Nangaon (Poona) is being formed with a view to manage the water lifted by Government Pumping Plant erected on Bhima River.

11. *Implement Societies.*—Four Implement Societies have been formed. Two of these are in the Satara District (Vangi and Vasi) and two in the Poona District (Talegaon-Dhamdhere and Ramwadi).

12. *Co-operative Farming Societies.*—One at Arjunsond (Sholapur) and one at Bhambora (Ahmednagar) are formed. The Deputy Director of Agriculture is not directly concerned with these though help is given when sought.

13. *Agricultural Engineering.*—Due to the devolution of the Agricultural Engineering section of the Department, the district work of the Agricultural Engineer including Boring is transferred to the Deputy Director of Agriculture. From the short experience of five months it can be said that it is a useful change, in the interest of the farmers, though it has added considerably to the administrative and office work of the Deputy Director. The staff lent, however, is not accustomed to serious and steady work.

In connection with boring it is found hard to secure carts from the applicants and even from the Mamlatdars when these have to be impressed for shifting the machines and necessarily several days work is lost. Moreover, except at Sholapur (city) concentrated work could not be got and hence shifting absorbs considerable time. It is also observed that of the number of enquiries only about half are finally registered with deposits. The experience of lending machines, wherever possible, to Taluka Local Board seems more advantageous. The machine lent to the Madha Taluka Board is kept fairly busy. The following table shows the work of the Boring section done from 1st February 1923 to the end of June. It also shows the non-working days and the reasons for stoppage :—

Machine Number.	How utilized from 1st February 1923 to 30th June 1923.					Average work done per day.	Number of bores.			Number of feet bored.	Remarks.
	Idle for want of				Working days.		Successful.	Unsuccessful.	In progress.		
	Coolies and carts.	Holidays.	Repairs.	Applications.							
17 Poona District.	·38	11	..	28	93	4′-1″	1	1	1	295′-2″	
25 Satara District.	84	7	20	..	39	2′-8″	3	2	..	94′-8″	
8 Do. ..	74	9	24	..	43	6′-7″	2	1	..	291′	
28 Sholapur District ..	98	..	38	..	14	4′-4″	1	..	..	61′	
13 Sholapur with Madha Taluka Association ..	..	21	15	..	54	5′-8″	2	2	..	308′-6″	
	..	..	..	..	243	..	9	6	1	1,050′-4″	

Difficulties are studied and attempts are made to overcome these and it is expected that better results can be achieved in future.

Regarding other mechanical works it has to be noted that for the most part both the mechanical assistants had to spend the major portion of their time at Manjri Farm in attending to the repairs of the power crusher which was not in a fit condition. Besides the work at Manjri and a few days work at Loni one assistant was working with Mr. Wadkar for 47 days as a driver of No. 44, Chattnuga Mill which was hired to him. This work has made good impression on the farmers in the neighbourhood of Hadapsar. Besides two pumping sites were inspected and help was given to some of the farmers on Godawari Canal.

14. *Vernacular Agricultural School, Lōni.*—In addition to the regular training of boys in the two classes five trained teachers were received for training as per Government Resolution. These teachers have now finished their course, and four new ones have been received. The resolution expects the Agricultural Department to coach these teachers in Agriculture and other subjects bearing on rural needs. Some of the subjects especially agricultural co-operation (including non-credit co-operation) is new and is just developing in this part of the country. To partly relieve the staff and also to equip them for this work, I take one hour a week when I go to inspect Manjri and Loni Farms. These lectures are attended by the teachers under training, the boys in the school as also the staff of the school.

There were 27 boys in the first and 22 in the second year, out of which 22 in the first and 22 in the second year passed. The following shows the castes of their parents :—

	1st year.	2nd year.
Marathas, Kunbis, etc.	13	13
Brahmins	12	4
Others	2	5
Total ..	27	22

Though the school is running for over 12 years and though the school is always nearly full, there is not much rush for admission. The reason seems to be more economic than the usefulness or otherwise of the training given. The holdings in this part are small and these do not afford enough scope for the trained farmer. The new experiment of introducing agriculture in primary schools, which holds great prospects will enhance the value of the schools of Loni type. In fact, Loni School has entered its additional and possibly its most useful field.

The following shows the value of produce grown, amounts remitted into the treasury, additional amount spent, total cost per boy, monthly cost of boarding per boy :—

Year.	Number of boarders.		Cost of produce grown on the farm.	Amount credited into Treasury.		Additional amount spent including pay of the establishment.	Cost per boy per year including pay of the establishment.	Boarding cost per boy per month.	Remarks.
	Boys average per year.	Teachers.		By the Head Master.	By the Director.				
			Rs.	Rs.	Rs.	Rs.	Rs.	Rs. a. p.	
1919-20 ..	33	..	2,005	966	1,152	14,915	448	17 0 0	
1920-21 ..	37·5	..	2,631	1,172	1,980	15,227	392	15 11 0	
1921-22 ..	44·8	..	2,794	940	1,892	16,121	359	13 6 0	
1922-23 ..	44·8	5	*4,077	1,389	2,086	14,706	340	12 1 6	

* Subject to the Auditor's Verification.

15. *Distribution of Seeds, Implements and Manuers.*—The following statement gives the details of the distribution of seeds, manures and implements, etc. :—

	Seeds.				Manures.		Implements.		Copper Sulphate packets.
	Quantity.	Rs.	a.	p.	Quantity.	Value.	No.	Value.	
Sholapur ..	8,361	711	0	0	25,800	4,515	21	1,372	153
Satara ..	3,623	552	0	0	..	..	..	..	135
Nagar ..	27,931	3,977	0	0	..	..	201	11,171	150
Poona ..	111	172	0	0	5,150	504	9	270	169
Canal Tract ..	23,395	2,297	0	0	200,066	26,379	367	3,976	868
Total ..	63,421	7,709	0	0	231,016	31,398	598	16,789	1,505

The Noria or Bulsar *Rahat* is gaining popularity amongst the irrigators on the canal tract and the Divisional Superintendent has arranged for the supply of five such *Rahats.* The growing demand has encouraged the construction of such *Rahats* locally.

16. *Implement Depôts.*—The old depôts have done useful work of introducing iron implements, especially iron ploughs. The depôts supply spare parts also. When original work is done by the Agricultural Department, the Government Depôt is shifted to a new tract transferring the work either to Co-operative Society or to private enterprise. During the year under report, Depôt work at Shevgaon is taken over and largely expanded by Co-operative Implement Society at Shevgaon. The Agricultural Overseer, Ahmednagar, has managed this very tactfully. The total amount of hire charges collected during the year amounted to Rs. 3,047-12-9 chiefly in the Ahmednagar District.

		No.
Canal tract		48
Sugarcanes ..	18	
Wheat ..	6	
Turmeric ..	10	
Other crops ..	14	
	48	
Poona District ..		6
Nagar ,, ..		29
Satara ,, ..		4
Sholapur ,, ..		4

17. *Demonstration plots.*—For demonstrating the methods of proved value the marginally noted demonstration plots were laid out in the cultivators' fields. Large number of these plots wer managed with the help of the members of the Kolhar Irrigation Society. The good results have attracted the attention of the people.

18. *Mohol plot.*—The work at Mohol was continued. The plot had yielded a good outturn of cotton last year, in spite of the long break in rains. The year under report was most unsuited for cotton. Monsoon broke late and rainfall was insufficient for sowing and good growth. There was very little rain fall in August, September and October and consequently hoeing could not help the crop much. Dry farming methods to be successful require a certain minimum rainfall, well distributed during the period of the growth of the crop and it is borne out by the evidence at Mohol. In the year 1921-22 though the rainfall was not

sufficient for cotton it was not as bad as in the year under report and so we could raise cotton last year successfully though other farmers failed. During the year under report all the case was of no avail.

The total rainfall of the year was 15·79 inches only : yet its distribution was comparatively better suited *rabi* crops and we could, with due care, get a better harvest of *jowar* than in the neighbourhood.

The following shows the comparative yields of plots under different treatments :—

Plot.	Cultivation.	Grain and Fodder per acre.	
		Grain.	Fodder.
		Lbs.	Lbs.
1	Ploughed 4 times harrowed. 2 times hand hoed.	728	1,740
2	Unploughed 4 times harrowed. 2 times hand hoed.	650	1,680
3	Neighbourers' fields Harrowed. Hoed.	406	900

It will be seen that good cultivation of the farm has increased the outturn about 80 per cent. over the common cultivation of a neighbouring farmer. Ploughing, however, does not show sufficient increase to cover the cost of this operation.

19. *Demonstration and Shows.*—Twenty-seven small demonstrations were held during the year under report—twelve in Sholapur District, six in Satara, three in Poona, one in Ahmednagar, and five in Canal tracts. Of these Varur and Pandharpur were fairly large demonstrations. It is found that such small demonstrations are less costly and yet very useful. In the Central Provinces village meetings and field discussion are insisted upon. The district staff in South Central Division held field discussion but village meetings, except on occasions of demonstration, were rare. I am desiring the staff to hold such meetings in larger number when they are in the district. I personally had quite a large number of such discussion meetings.

20. *General.*—The usual district work is continued throughout the division. The increasing enquiries from the public and from the Government officials are promptly attended to. During the year under report several sugarcane mills were tested and number of articles contributed to the College Magazine and Shetki and Shetkari by the Deputy Director and his staff.

The staff has put in good year's work.

(Signed) P. PATIL,
Deputy Director of Agriculture,
S. C. D., Poona.

Poona dated 27th August 1923.

APPENDIX D.

Administration Report and Summary of Work done by the Deputy Director of Agriculture, Southern Division, for the year 1922-23.

Staff and Organisation.

1. Mr. Gilbert held charge of the office of the Deputy Director of Agriculture, S. D., till 16th May 1923 when he went on leave. I hence, assumed charge of this office only for the last few days of the year under report. The principle of organisation in sections each responsible through its head to the Deputy Director of Agriculture continued. Under retrenchment the post of the Divisional Superintendent was kept vacant from 1st September 1922. The strength of the District staff was however increased to a certain extent. Each District has during the year been under one Inspector responsible as a head of section to the Deputy Director of Agriculture. The Inspector of Agriculture, Dharwar District, has two fieldmen, one graduate working from the Haveri centre and the other non-graduate working from Gadag. The Inspector of Agriculture, Belgaum District, has also two fieldmen, one graduate with headquarters at Chikodi and the other non-graduate at Bailhongal. The Inspector of Agriculture, Bijapur District, has one non-graduate fieldman with head-quarters station at Bagalkot. There was no material change in other sections.

2. The Boring staff and the Mechanical Assistant were transferred to the control of the Deputy Director of Agriculture from that of the Agricultural Engineer, Bombay Presidency, Poona, from 1st February 1923.

The Agricultural Organisers were also transferred to the control of the Deputy Director from that of the Assistant Registrar, Co-operative Societies, S. D., during the year under report.

On demand from the people, a separate officer for advice on the embankment of land was considered necessary and a graduate fieldman was selected from 1st September 1922 to study the subject and do this special work.

3. The Deputy Director was the Chairman of the Divisional Board the organisation of which was referred to in paragraph 3 of the last year's annual report through almost the whole of the year, and he conducted four ordinary quarterly meetings of that Board.

4. The work done by various sections will be summarised under the following heads :—(*a*) Experiments, (*b*) Propaganda, (*c*) Agricultural Education and (*d*) Miscellaneous.

Experiments.

5. Experiments were conducted mainly on Government farms—Dharwar, Gokak, Gadag, and Tegur, and a few in cultivators' fields.

6. *Dharwar Farm* is rising in importance mainly as a Plant Breeding station. The breeding work is steadily extending under Mr. Kottur and is becoming more useful to the public. In cotton, the cross between Dharwar No. 1 and Rosea which reached its fifth generation engaged his main attention. The results of his studies on the inheritance of some of the characters in this cross were submitted for publication. Up till the fourth generation, selection was based on three characters, *viz.*, high ginning, long staple and white colour. In the fifth generation the number of plants pure for all these three characters being found sufficiently large, 120 plants were selected specially for high yielding character. All these are derived from three plants of the second generation of the cross and seem to have a great future.

7. In previous years a small number of low ginning plants was traced in lines pure for high ginning. The cause of this discrepancy had not been found out. This year on detailed observations wilt was found to be the cause of it. On the same plant *Kapas* from affected branches gave a lower ginning percentage than that of healthy branches. Wilt seems to be a disturbing factor in the case of ginning percentage and further investigations on this point will be continued by Mr. Kottur.

8. *Wilt.*—The same plot which was infected last year was re-infected with wilt spores. Nine varieties were tried Kumpta, Dharwar No. 1, 2, 3, 4 and 5, *Wagale* (pure strain), *Bishur Jari* (not pure), Rozi (Nadiad) and a cross of Dharwar No. 1 and *Wagale*, and the number of plants attacked in each variety was counted. *Wagale* withstood the attack of wilt very remarkably, like last year. Dharwar No. 2 and Kumpta stood next but Kumpta fared better than Dharwar No. 2. This indicates that Kumpta cotton contains types which resist wilt better than Dharwar No. 2. Some resistant plants in Kumpta have been selected for further study. The susceptibility of Dharwar No. 1 cotton was proved. The first generation of the cross between Dharwar No. 1 and a pure wilt resistant strain of *Wagale* shows that resistance is dominant at least during the greater part of the growing period. Further observations will continue. The first generation of the cross between susceptible parents Dharwar No. 1 and Rosea has yielded plants more resistant than either parents. These will be tested further.

9. Observations on the cross between Gadag No. 1 and Sea Island Cottons continued. The Red Leaf Blight was very severe and many plants of the second generation of the cross succumbed to it.

10. Breeding work on *Jowar* consisted mainly in purification of some of the important varieties and selection in local varieties for yield, *Chavari*, *Nandyal*, *Bilichagan* (striga resistant) *Wagar* Holgi, Gidgempu, *Ranebennur*, Fulgar white, Fulgar yellow, *Handimasdi* (white grained) were pure and true to type. *Holgi* is an early variety and flowers at the end of September. If cut at this time it ratoons well and gives a good yield in the *Rabi* season. Selection for yield was done in *Fulgar* yellow, *Fulgar* white Nandyal and Mahisal varieties. In order to study the relation

between weight of grains and the length of rachis, measurements and weights of 500 individuals in Nandyal and Fulgar varieties have been recorded and the figures are being worked out.

11. A certain amount of selection in Local wheat was done on the basis of the number of spikelets per spike.

12. Other experiments conducted by Mr. Shevade, the Superintendent of the farm, were on crops, on manure, on cultures and on field embankments.

13. *Crop Experiments.*—Comparison between Dharwar No. 1 and Kumpta cotton was important. Dharwar No. 1 yielded less than Kumpta due to greater attack from wilt, but as it received better prices for *Kapas* fetched nearly the same net profit per acre. Dharwar No. 1 has a great future, if the wilt problem is solved. The attack of wilt is not so much in cultivators' fields as is on the farm and cultivation of Dharwar No. 1 is steadily extending. Comparison made between local and *Bansi* wheat is in favour of the former. The trial of Lucern as a dry crop for green fodder gave very encouraging results. 18,386 lbs. green fodder valuing Rs. 244 was obtained in six cuttings at a cost of Rs. 105 giving a net profit of Rs. 139 per acre. The trial of tobacco was encouraging and will be repeated during the next season.

14. *Manurial Experiments.*—Application of 10 tons farm yard manure per acre every second year to the *jowar* crop has given the best results and that of 15 tons per acre is found to be not paying. Crude night soil applied to a plot in 1914-15 at the rate of 20 tons per acre is still showing its effects on the *jowar* crop. Average results of the experiment of ploughing in farm yard manure versus spreading this manure conducted for the last eight years are in favour of spreading the manure.

15. *Cultural Experiments.*—Deep versus shallow tillage experiment in clean black land is in favour of the latter. Diching is found to be better than ordinary ploughing once in two years. Experiments for eradicating *Striga lutea* were in progress and will take some time more before any recommendation can be made.

16. Dharwar farm besides conducting experiments continued to maintain an implement depôt and a workshop attached to it. In all, implements worth Rs. 3,096 were sold from the depôt. Mr. Shevde besides attending to farm duties continued to work as Secretary to the District Agricultural Association, Dharwar.

17. *Gokak Farm.*—Mr. Neginhal, the Superintendent of this farm, has worked mainly with a view to make the farm pay and conducted many useful experiments as well.

18. *Manurial Experiments.*—Artificial manure to the sugarcane crop was given with advantage in three doses instead of only once at the time of earthing up. Trash manure to the cane crop gave good results and needs recommendation to cultivators of cane in the Canal tract. Green manuring with gram in the Rabi season has given better results than that

with sunflower on the succeeding Maize crop. Ten tons of farm yard manure per acre to the Rabi Maize Crop was found to be more paying than the usual rate of 7½ tons per acre on the sandy soil of the Gokak Farm. Green manuring with *Sann* in the *Kharif* season was better than that with sunflower for the succeeding *Rabi Jowar* crop. Top-dressing paddy with oilcake manure at the rate of 10 to 20 lbs. Nitrogen per acre was found to be very paying and deserves recommendation to cultivators. Top-dressing turmeric with cake at the rate of 40 lbs. Nitrogen per acre in the form of oilcake, in addition to an ordinary dose of 7½ tons farm yard manure, has considerably increased the yield and net profits. Contrary to the experience on Dharwar farm, ploughing in farm yard manure has given better results than spreading this manure on the surface.

19. *Crop Experiments.*—In the trial of cane varieties, yellow Mauritius has attracted attention. It gives better germination than others in sticky and *Karl* soils. It is less attacked by borers, is more drought resistant than Pundia and its *gul* is better than that of Red Mauritius, and as good as that of Pundia. This variety has scope in sticky and *Karl* soils in the Gokak Canal tract. Dharwar No. 5 cotton has given better results than Dharwar No. 3 and its cultivation is likely to extend in the tract. Seed has been preserved for extensive trials in cultivators' fields.

20. The garden on Gokak farm has now become a paying concern. The method of slow irrigation and the concrete channel referred in the last year's annual report were prominent features in orchard management. The alkali land on the farm has considerably improved and has produced good crops of paddy and cotton.

21. Besides field experiments the farm undertook experiments on storage of *gul* and on methods of killing pigs and jackals. Maize silage was prepared after removing cobs with great profit. Six hundred bags of cake manure was sold from the farm depôt to the cultivators of the canal tract. The total sale proceeds of the depôt have gone to Rs. 5,100 which reflects credit to the farm.

22. *Gadag Farm.*—Experiments on the Gadag farm totally failed owing to failure of rains and there is nothing worth recording.

23. *Tegur Farm.*—The herd of cattle is now well established. The progeny of the new bull is better than that of the previous ones. All cross-bred bullocks have fetched a better price than country ones.

A good quantity of fodder was grown in *Kharif* season at a cheap cost. It is hoped that Tegur farm will soon be in a position to demonstrate the advantages of mixed farming in the *Mallad* tract where lands are lying waste.

Observations on grasses and methods of hay and silo making continued. The disease *Strongylus contortus* was traced by the Veterinary Assistant and all precautionary measures were adopted. Treatment with copper sulphate was found very valuable for keeping up the condition of cattle and for preventing the spread of the disease.

Sheep maintained on the farm did also fairly well but the number is too small to make the concern pay.

24. A Rice breeding station was established at Mugad at the close of the year under report. Many sites were inspected in different places and one was finally selected at Mugad, where important series of experiments in rice selection for the *Mallad* tract have been established.

25. *Experiments in cultivators' fields.*—The district staff conducted a number of experiments with bone meal and oilcake manure to the paddy crop, and oilcake and sulphate of ammonia to the sugarcane crop. The use of bone meal for the paddy crop is extending round Khanapur, and of oilcake and sulphate of ammonia for the sugarcane crop in the Gokak Canal tract and in Chikodi and Hukeri talukas of the Belgaum District. Trial of early varieties of groundnut was undertaken in three new places in the Belgaum District and in four in the Dharwar District. Cultivation of the Spanish peanut variety is largely extending in the Haveri taluka of the Dharwar District. *Bansi* wheat was compared with local in three places. Results at Aminbhavi in Dharwar District were good but elsewhere the crop suffered from want of rain. Trial of turmeric at Devi-hosur in garden land gave very encouraging yields and its cultivation is likely to extend in cocoanut gardens situated in the belt running from Hangal to Haveri in the Dharwar District.

Propaganda.

26. *Demonstrations.*—In all thirty demonstrations were conducted in Dharwar, forty in Belgaum and eight in Bijapur. Most of them were of improved implements, notably of iron ploughs, wheat-threshers, and the stone roller for threshing. A few were of cane crushing with the *Nahan* mill and *gul*-making on the Poona furnace and others were of standing crops in experimental plots in cultivators' fields above referred to. Many of the demonstrations were arranged in co-operative Union centres and along with co-operative conferences. Ploughing competitions were held in three places in Belgaum, two in Dharwar and one in Bijapur District. All demonstrations were followed by lectures on useful subjects and many included steeping *jowar* seed in copper sulphate solution. Exhibitions of agricultural produce were arranged along with Aminbhavi and Alur Co-operative conferences and with a Cattle Show at Aminbhavi.

27. A training class was arranged on Dharwar farm for Secretaries and members of the non-credit agricultural societies. A series of lectures on different subjects were given to them, and ploughing and handling of various other implements were also taught to them.

28. *Distribution of improved implements, manure and seed to cultivators.*—As a result of our experiments and demonstrations in cultivators' fields, the demand for improved implements (chiefly iron ploughs and Nahan mills), bone meal, cake manure and sulphate of ammonia is steadily increasing. After the close of the Belgaum depôt the Union Agency has captured the market for sulphate of Ammonia and Messrs. Gavade and

Shirgaonkar for Nahan mills. The Inspector of Agriculture, Belgaum, reports that Messrs. Gavade and Shirgaonkar sold 30 Nahan mills and that the total sales of implements and manures by these two private firms reached to Rs. 25,000 during the year. I have already stated in paragraph 23 that Gokak farm sold 600 bags of cake manure. Many local middlemen deal in this cake manure and bone meal. The business of hiring out iron ploughs is mainly taken up by Associations and Co-operative societies in the Dharwar and Belgaum districts and by middlemen in the Bijapur District. A new Government depôt was started at Bailhongal at the demand of the people, and the total sales of iron ploughs have reached to Rs. 1,048. The next step under contemplation is to start there a co-operative society during the next season. The Keatinge Implement depôt at Devi-hosur is doing very good work.

29. *Associations, Non-credit agricultural societies and Taluka Development Associations.*—Among old associations Dharwar District Agricultural Association continued to do good work of hiring out iron ploughs, and its Magazine is running but needs improvement. The Association completed its new building and got it opened by Dr. Mann, the Director of Agriculture, Bombay Presidency, Poona, with a Mango Show arranged inside the building. The Athani Taluka Association also did good work of hiring out iron ploughs and has undertaken boring work by purchasing a machine. This body has applied for registration under the Co-operative Act, and has changed its name to Taluka Development Association. Saundatti and Benadi Associations newly started for hiring out iron ploughs are steadily extending their business. All other old associations have remained inactive.

30. Co-operative non-credit agricultural societies started for supply of improved implements, seed and manure and for hiring out iron ploughs are in general slowly but steadily increasing their business. There are 37 such societies in all in Southern Division, 10 Implement, 20 seed and implement, 5 seed and 2 Manure societies. Among these, Hosritti seed and Implement society, Devi-hosur seed society and Belladbagewadi Manure society are doing very good work. Others are yet slow in their progress but Mr. Patil, the Agricultural Organiser, reports fair and good hopes for many. Success of these societies, I think, largely depends upon educating the minds of cultivators to forecast their indents ; otherwise the middleman has always his place and part to play. Now that the whole district staff will be in touch with these societies each in his own area, it is hoped that they will be able to improve them to a considerable extent. It is desirable that all business bodies be registered under the Co-operative Act, and attempts will be made to convert all small working old associations referred to in the above paragraph into co-operative bodies and to get them registered.

31. *Taluka Development Associations.*—The organisation of these associations was planned by Government and notified in the Press Note No. 2962, dated 21st October 1921, Revenue Department, and they have been started in the Dharwar, Gadag and Ron talukas of the Dharwar

district, Athani, Chikodi and Gokak talukas of the Belgaum District, and Indi Taluka of the Bijapur District. The District staff was busy in surveying the local agricultural needs of these talukas and preparing programmes of their work and budgets. Associations have approached the Director of Agriculture for Government subsidy and all except Gadag have approached the Registrar for their registration under the Co-operative Act. Dharwar, Gadag and Ron got their subsidy and commenced their work during the year. Dharwar Taluka Development Association did good work. Four ploughing and four steeping demonstrations were conducted in different centres. Boring work was undertaken. Intensive propaganda on steeping *jowar* seed was done in the area of the Aminbhavi Union. An Educational society at Garag and Mango cultivation society at Aminbhavi are being worked. Other associations have just appointed their fieldmen and commenced their work.

32. *Organisation and campaign against wild pigs.*—The villages in the *mallad* bordering the forest area suffer much from the attack of wild pigs to their crops so much so that the very existence of the people is being threatened out. No attempts to introduce agricultural improvements are likely to be successful there without organisation to fight out the pig.

Personally much of my attention was devoted to this subject. Four new co-operative fencing societies were organised in the Kalghatgi Taluka, and walls of the type of that already built at Mandihal but of bigger dimensions (3 feet at the bottom 1½ feet at the top and 5 feet tall) are being built. In three villages construction is nearly completed and in the fourth it is fast in progress. Attempts to induce all the people of a village without exception to join the scheme, fixing the exact line of fence to suit all, but to run as straight as possible and the question of dividing the estimated cost of fence among the members, took a great deal of my time and energy in organising these schemes. The estimated benefits of these schemes are immense but only experience will tell us how much will actually be realised. Many such schemes are under contemplation in Kalghatgi Taluka. Some western villages of Mundargi Petha also suffer much from the attack of wild pigs. There prickly pear has become the abode of pigs. A site at Tambargundi was cleaned of its pear growth during the year through an unregistered co-operative organisation, at nominal cost to individual cultivators but with great benefit to them. Mr. V. H. Naik, the Deputy Collector of that Division, took interest in the scheme and has helped it with a tagavi loan from Government. A campaign for removal of prickly pear from the whole of Mundargi Petha is under consideration and is being worked out, and this work against pig has been largely appreciated by the cultivating public.

33. *Organisation for steeping jowar seed.*—in copper sulphate solution against smut through officers of the Revenue Department was planned in obedience to Government Resolution No. 6799, dated 19th February 1923, and demonstrations were held in all taluka centres by the District

staff. 29,000 copper sulphate packets in Dharwar District, 18,500 in Belgaum District and 12,000 in Bijapur District have been distributed. Further propaganda is in progress.

34. *Cotton work.*—Extensive trials of Dharwar No. 1 Cotton seed against Kumpta in nine places and Gadag No. 1 cotton seed against Dharwar-American ordinary in three places were undertaken. Results are on the whole in favour of the introduced improved types. Mr. Dharwarkar, the Cotton Superintendent, with the aid of his staff distributed farm seed as usual to seed-growers and controlled an area of 5,618 acres under Dharwar No. 1 and 7,136 acres under Gadag No. 1 cottons to raise seeds for general distribution. The total area under pure seed of known origin of the two introduced varieties estimated by the seed distribution done by sale societies and the Savanur centre was 38,980 acres under Dharwar No. 1 and 45,456 acres under Gadag No. 1.

Crop demonstrations were held in different centres and good propaganda was done through cotton staff and seed-organiser to induce cultivators to sell their *kapas* through sale societies. Rao Saheb Shirhatti, Secretary of the Hubli Cotton Sale Society, undertook with the aid of our Cotton staff propaganda during the year in favour of clean picking of *kapas*, and worked hard on it. The propaganda was much hampered by unusual rains in March but has left a good impression on the minds of the cultivators. A good deal of cotton was picked clean, and prizes were awarded by the Hubli Cotton Sale Society, in whose auctions it received exceptional prizes.

The business done by various co-operative cotton sale societies runs as under :—

Name of society.	Number of dokras sold.	Value of cotton sold.
		Rs.
Hubli	9,949	7,40,000
Gadag	6,370	4,98,000
Bailhongal	2,000	1,45,000
Dharwar	1,030	72,000
Haveri	810	58,000
Bagalkot	215	15,000
Annigeri	400	28,000

Hubli Society mostly dealt with Dharwar No. 1 cotton, and Gadag with Gadag No. 1. Other Sale societies sold mostly Kumpta Ordinary. In all twelve auction sales were held and grading work was done under the supervision of the cotton staff. On an average Dharwar No. 1 fetched Rs. 18 more per *naga* than ordinary kumpta, and Gadag No. 1 Rs. 40 more than Dharwar-American ordinary. The Cotton Superintendent estimates that an extra profit of Rs. 1,22,281 was realised from these auction sales. The success of auction sales largely depends upon improved types of cotton and it is mainly why in other centres than Hubli and Gadag the business is small. For general distribution during the

coming season the Hubli sale society has stocked 534,180 lbs. of Dharwar No. 1 seed at Hubli and the District Agricultural Association, Dharwar, has stored 120,000 lbs. at Savanur. The total quantity will suffice for 70,000 acres, nearly double the area that was sown during the year under report. The Gadag cotton sale society has stocked 363,793 lbs. of Gadag No. 1 cotton seed, almost equal to that stored during last season.

Mr. Shetti concentrated his attention mainly on the improvement of the Bailhongal Cotton Sale Society which met opposition from dalals and on the Haveri Sale Society which was newly started during the year under report.

35. *Other important Sale Societies.*—A Chillie Sale Society at Byadgi sold 4,858 maunds (of 80 lbs. each) of chillies worth Rs. 39,357. It is reported to have done good business but failed to follow some co-operative principles. A Tobacco Sale Society was started at Nippani and it has just commenced its operations. A Betel-leaf Sale Society at Hattimattur is being worked out.

36. *Cattle Breeding Societies.*—They are twelve in the Division, six in the *Maïlad*, two on the bank of the river Krishna and four in the dry tract of Mundargi Petha along the Kappat Hills. The societies in Mundargi Petha have suspended their work owing to failure of rains while the rest are reported to be working fairly well. Good cultivators have appreciated the introduction of the Mysore strain of cattle, but management in societies is not yet very satisfactory. The necessity of castrating mongrels is not realised by the members. Mr. Tivari, the Organiser for the Cattle Breeding societies, has received applications for more societies but is asked to concentrate on improving the condition of those existing at present.

37. *Boring work.*—In all 18 bores were taken in the Division ; the following are the details :—

Name of district.	Successful.	Failure.	Rejected at owner's request.	Incomplete.	Total.
Dharwar	10	..	2	1	13
Belgaum	2	1	..	1	4
Bijapur	..	1	..	..	1
	12	2	2	2	18

Ten out of 18 bores were purely for agricultural purpose. The work was more or less stopped during rains. Out of 5 machines only 3 worked during the year. The total receipts amounted to Rs. 4,176 whereas the expenses came to Rs. 3,352. The number of applications for boring is increasing, but it is not possible with the present number of machines to cope with the

demand. It was suggested during the year that Local Boards should get men trained to work their machines. The Taluka Local Boards, Navalgund and Shiggaon, sent their men for training. A mechanic has been lent to the Athani agricultural association. Gadag and Hubli Taluka Local Board Machines were worked for a time under the supervision of Mr. Modak, the Boring Assistant, and their men were trained.

38. *Field Embankments.*—The special officer Mr. R. B. Mutalik-desai spent much of his time in studying the subject. He has prepared nine plans in the Dharwar District and nine in the Bijapur District. Execution of two of these schemes has been undertaken and that of the rest will begin after the rains. Some plans largely deal with prevention of surface erosion and conservation of moisture, while others offer problems of controlling fairly large nallas with a view to accumulate silt.

Agricultural Education.

39. The Vernacular Agricultural School at Devihosur continued to prosper under Mr. R. Y. Hulkoti, its Head Master. 22 students were on the roll, but one left in the middle of the second term. Applicants for admission were many, but rigorous selection was made with a view towards efficiency. A small laboratory is newly equipped and the elementary principles of some mechanical appliances which the cultivator is often required to deal with, are taught. Theory portions are commonly dealt with in class rooms for three hours between 12 a.m. and 3 p.m., while at other time of the day the students are made to work in fields with practical lessons on each operation. Each student is given fair practice in the workshop just sufficient to remove his dependence on the local carpenter or smith for petty repairs. He utilises his spare time in weaving and rope-making. Thus the students are practically busy in one or other works useful to them in their after life. During the year under review nine out of ten boys in the first year and eight out of eleven boys in the 2nd year have passed. The cost of educating a boy at the school came to Rs. 40 per mensem which is high indeed. This is because great many of the subjects which can be taught at a greatly reduced cost at the primary schools with slight additional training to the teachers there, are taught here by highly paid officers. The introduction of the proposed agricultural course into rural primary schools which is now being thought over will solve this problem.

Miscellaneous work.

40. Demand for fruit trees and for advice in fruit growing was large but could not be adequately met. Eight hundred mango grafts were ordered from Ratnagiri and distributed mainly round Dharwar. The Inspector of Agriculture, Belgaum, attended to renovation of ten dwindling gardens. The cultivators of the Southern Division know well how to grow crops, but are generally wanting in the knowledge of fruit growing. Here is the real field for work. A nursery and a trained mali are bad needs of the Division.

41. Enclosure against pig in the *mallad* and embanking against surface erosion which are the real needs of the cultivators in Southern Division have now been extensively taken up. The Registrar, Co-operative Societies, Bombay Presidency, kindly arranged to advance adequate loans to fencing societies and to individuals for embanking. He has ruled that applications for loans over Rs. 1,000 should be recommended by the Deputy Director. Most of the applications from individuals come from the Gadag division of the Dharwar District and the District Agricultural Overseer, Gadag, was very busy in inspecting fields of applicants and making designs and estimates. Common embanking schemes are difficult to be worked out but a few are under contemplation.

42. The duties of District Agricultural Overseers have now been so multifarious that each badly needs a *kamgar* under him for field work. I firmly believe that money spent on *kamgars* is well spent. Cultivators are slow to adopt improvements and *kamgars* selected from among them will play an important part in bringing out the desired progress. He will actually work with cultivators and get the advice of the Overseer acted upon.

(Signed) S. S. SALIMATH,

Acting Deputy Director of Agriculture,
Southern Division, Dharwar.

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APPENDIX E.

SUMMARY OF WORK DONE BY THE DEPUTY DIRECTOR OF AGRICULTURE, GUJARAT DIVISION, FOR THE YEAR 1922-23.

I. Staff.

I was in charge of the Division throughout the year.

2. The organisation of the subordinate staff was the same as reported last year on page 42 of the Department's Report for 1921-22, except that there was no temporary Cotton Establishment and that the Boring Staff was added to this Division, owing to its transfer from the control of the Agricultural Engineer, B. P., Poona, from 1st February 1923.

3. An important feature during the year was the formation of the Gujarat Divisional Board representing the Agricultural and Co-operative Departments and including a majority of non-official members to control the propaganda work of both the Departments above referred to in the Division. By the introduction of this new scheme it is hoped to enable the local bodies to do much more active work for developing their local areas. For pushing on agricultural co-operative propaganda work the services of the Agricultural Organiser, Co-operative Societies, N. D., have also been placed from 1st November 1922 under my executive control.

II. Experimental and Research Work.

4. *Cotton Breeding at Surat and Broach.*—As decided last year, only the pure strain of cotton named 1027 A. L. F. was sown all over the cotton area of the Surat farm, and the resulting seed was distributed in the Athwa Group in the season for 1923-24. A comparative trial of this strain with the local cotton gives the following results :—

Variety.	Yield in lbs. per acre.	Ginning percentage.	Length of fibre centimeters.
Surti Local	570	35·1	2·2
1027 A. L. F.	613	37·0	2·8

The Millowners' Association, Bombay, reported the value of the improved cotton at Rs. 75 per *Khandi* more than the ordinary Surat cotton. This is satisfactory, but with a view to obtain better strains of cotton, the work on crosses mentioned in paragraph 6 of the last year's Annual Report was continued, and the results are exceedingly promising.

5. Preliminary observations were made by Mr. M. L. Patel, Cotton Breeder, South Gujarat, on the causes of shedding of flower buds and young

bolls. But the matter is so complicated and yet so important that the continuation of this work will be placed in future in the hands of special staff, the cost of the whole investigation being provided by the Indian Central Cotton Committee.

6. Certain selections of cotton made at Surat and considered suitable north of the Narbada were again tested at Broach during the year. The best of these (Cylindrical Boll 1) gave the following results :—

Variety.	Yield in lbs. per acre.	Ginning percentage.	Length of staple centimeters.
Broach Deshi (Pure)	428	37·8	2·14
Cylindrical Boll I A.	461	37·0	2·4

The Cotton was valued by the Millowners' Association, Bombay, at Rs. 30 per *Khandi* more than ordinary pure Broach *deshi* cotton. The seed obtained at the Broach Farm from this during the year, about 2,260 lbs., was distributed to selected cultivators of the Broach District.

7. *Cotton Breeding at Viramgaum.*—The five strains of *Wagad* cotton mentioned in paragraph 11 of the last year's report were again under observation in the year under report and the characters that were observed were mostly constant. Their yield, etc., and valuations reported were as under :—

Name of strain.	Yield of Kapas in lbs. per acre.	Ginning percentage.	Valuations.	Remarks.
			Rs.	
1. Wagad, white flowered.	572	39·6	540	Good for 20's.
2. Wagad No. 4 ..	790	42·5	565	Best of all, good for 24's.
3. Wagad No. 8 ..	820	45·5	550	Good for 20's.
4. Wagad No. 12 ..	820	45·0	500	Good for 16's.
5. Wagad No. 14 ..	770	46·0	540	Good for 20's.
6. Wagad, Local (from Mandal).	818	41·25	520	Good for 16's.

From the above it will be seen that Wagad Nos. 4 and 8 are exceedingly promising. The spare seed of these strains was given to the leading cultivators for trial and multiplication.

With a view to compare and study the *Wagad* cottons grown in different localities, samples from Patdi, Jagudan, Viramgaum and Mandal were grown and the results mostly show that their average ginning percentage is 41 per cent. and they are mostly poor and short in staple. Almost all of these were valued by the firm at Rs. 520 as against Rs. 550 of Fine Broach and Rs 565 of Fine Viramgaum. Few selections from these show much promise.

8. *Jowar Breeding at Surat.*—The study of the *jowar* plant on systematic lines was undertaken during the year under report, and a special graduate is put on this work under guidance of Mr. M. L. Patel, Cotton Breeder at Surat. Preliminary work of selecting pure strains and studying characters of different strains of *jowar* varieties is going on and it is hoped to get promising results in this line of work as in the case of cotton, before very long.

9. *Tobacco Breeding at Nadiad.*—Tobacco is a very important crop in the Kaira district. A lot of work was done on it in the past on the Nadiad Farm, with a view to get a leaf similar to Havannas and other valuable types grown in America. The main efforts were made at introducing the curing processes in vogue in America and trying varieties of seeds from best known places. But unfortunately all the efforts came to nothing. The Director of Agriculture suggested to tackle this question from a different standpoint and suggested to study the local types in an intensive way from botanical and cultural points of view. Accordingly Mr. V. M. Majmudar was specially put in charge of this work from 1st June 1922 and he has begun the study of the tobacco plant in the Kaira district in a systematic way under the guidance of the Director of Agriculture, the Deputy Director of Agriculture and M. L. Patel, Cotton Breeder.

As mentioned in paragraph 38 of the last year's report, the Nadiad Farm was wound up and the Association plot at Nadiad taken up from the Nadiad Agricultural Association and turned into a Tobacco breeding station from June 1922. During the season, 52 pure plants from five representative different types of tobacco grown in the District, *viz.*, (1) *Gandiu*, (2) *Pilliu*, (3) *Keliu*, (4) *Movadiu* and (5) *Shengiu*, have been isolated, and these will be studied from the various aspects of view for which tobacco is grown in the District.

One strain of tobacco from Pusa, *viz.*, Pusa 28 was also tried along with the local varieties. Though not comparing favourably in yield this year, the strain seems to be superior in strength and colour. Further trials will be continued.

10. *Surat Agricultural Station*: *Cotton.*—Cotton seed sufficient to sow the farm area with selected strain of 1027 A.L.F. was obtained from the breeding branch. The total area under this crop was 72 acres and 10 gunthas; and the average yield from this area was 480 lbs. per acre as against the average yield of 400 lbs. per acre in the surrounding villages of the Athwa Group. From this, 16,400 lbs. of pure seed was obtained for distribution in the Athwa Group villages.

Jowar.—The total area under *Jowar*, mostly *Perio*, was 65 acres 4 gunthas, and the average yield per acre was 799 lbs.

Cultural Experiments.—The experiments mentioned in paragraph 30 of last year's report were completed during the year under report and the results of the last seven years show that the yield of cotton increases by about 17 per cent. by dibbling the seed three feet apart as against sowing by drill two feet by one foot. This practice has now been

adopted on the farm and is strongly advocated and pushed in the district and the cultivators are adopting it largely. It may here be mentioned that there has been a wonderful evolution in the cultural methods of the District. Twenty years back the cotton and the *Jowar* crops in the District were sown very close. This was gradually widened on the Farm, and a wider spacing has generally been adopted by cultivators throughout the district with better results.

Ridging Experiments.—The experiments mentioned in paragraphs 31 and 32 of last year's report were put on a new basis to exactly determine the advantages of ridging with and without manure as compared with the ordinary flat system.

The increase in yield by sowing on ridges when no manure is applied is from 15 to 22 per cent. in the case of cotton, and 6 to 20 per cent. in the case of *jowar* grains while the fodder increases from 13 to 32 per cent. This is a fairly encouraging result, provided some method is evolved by which the preparing of ridges in the hot weather can be economically made. However this whole question is under investigation and it is hoped suitable methods will be evolved which will be within easy reach of the cultivators.

The principle of ridging is appreciated by the people as it ensures the young crop against water logging and the cultivators in the surrounding villages are adopting it as far as they can by the use of one paired implement. To encourage them Middle Buster ploughs worth Rs. 600 have been purchased by the Department, and propaganda is carried on to make their use popular. The striking advantage of ridge cultivation was demonstrated on the farm by the well established crop of the first sowings, when cultivators in some place had to resow their crop twice or thrice.

Breeding Herd.—The strength of the herd on 1st April 1923 was 94 as against 112 of last year, as 43 animals were sold off in public auction in the middle of February 1923. Cows Lehra and Budhi have yielded more than 3,000 lbs. of milk on an average of 10 years under observation. There were 34 births against 30 of last year and 9 deaths against 14. It is of special interest to note that the bull Devman has imported good milking quality to the present herd by increasing the average annual milk yield of his progeny by 489 lbs. The annual average of the mothers was 1,893 lbs. while their daughters by the above bull give 2,382 lbs. Similarly the bull Chavaria had shown his prepotence by increasing the milk yield from 2,228 lbs. to 2,710 lbs. The present bulls Kevdo and Deo are of known pedigree from good milkers, *viz.*, Lehra and Pitambari whose average yield is more than 3,000 lbs. and their prepotence in milk yield in their progeny is awaited with interest.

11. *Broach Farm.*—The work on this farm is principally confined to evolving suitable types of cotton for the Broach District and the work is in progress as reported above under Cotton Breeding. Selection work on *rabi jowar* has been started a year ago and pure types are being isolated for testing and propagating the seed.

Nitrate of Soda was tried as a top dressing manure on cotton at the rate of 135 lbs. per acre and the results of this season are very striking. It gave 94 per cent. more yield this season as against 19 per cent. of the last year. It will be tested further to see whether the increase in yield remains constant and the cost of manure is covered by the increase in yield.

12. *Dohad Farm—Wheat Seed Selections and Multiplications.*—A cross of the *Wajia* and *Popatia* wheats has at last been isolated in a pure condition and the pure strains are being multiplied for seed purposes on a large scale. In comparative trials with other varieties this cross has continued to give a higher yield and the average increase during the last three years over the local *wajia* comes to 14 per cent. The seven strains of *wajia* selected in the past were under further observation and it has been ascertained that of these the three strains selected for the spikeless character are much better than the rest and it has been arranged to multiply their seed for general sowing.

Pusa-4 wheat was shown on a large scale on an area of seven acres of the farm for seed purposes. The average yield from this was 1,205 lbs. per acre and the whole of this seed was given over to the Co-operative Central Bank, Dohad Branch, for distribution. As a dry crop in good land the yield was 1,142 lbs. per acre. In the market Pusa-4 fetched a price 17 per cent. higher than the local *Wajia*.

Wider planting of Maize.—Two feet between the rows has given better results during the past five years than the local practice of sowing fifteen to eighteen inches apart, and the average increase during this period comes to 22 per cent. This system is now being demonstrated and adopted on a large scale.

13. *Amalsad Farm—Sugarcane.*—There was no red-rot of sugarcane during the year. Seven varieties were under trial of which (1) Striped Mauritius and (2) Red Sports were found promising. Almost all the canes of these varieties were distributed as seed to the cultivators. Striped Mauritius ripens earlier than Red Sports, but the Local Malbari ripens even earlier than the above two. The crop as a whole was good and the yield canes per acre varied from 70,000 lbs. to 90,000 lbs. The system of planting canes by preparing land in ridges and furrows is becoming popular.

The turmeric crop which is usually sown in beds was compared with that sown on ridges and the results were 12,920 lbs. of rhizomes per acre in the bed system as against 15,408 lbs. on the ridge system.

III. Agricultural Education.

14. *Vernacular Agricultural School at Godhra.*—The school is now fully established, having completed its third year. Out of thirty-five applications for admission fifteen boys were selected and admitted. Thus

both the classes began with 13 boys in the 2nd year and 15 in the 1st year. According to caste and District they were represented as under :—

According to Caste—	No.	According to District—	No.
Brahmin	1	Panch Mahals ..	5
Dharalas	11	Broach	5
Patidars	14	Kaira	17
Gosai and Barot ..	2	Ahmedabad	1
Total ..	28	Total ..	28

The staff, curriculum, and methods of practical training and of the school farm management were almost the same as those reported in past years, all the farm work being done by the boys themselves. The subject of handweaving as a secondary occupation was added this year.

The annual examination was held in April 1923 by Messrs. G. N. Desai, Divisional Superintendent of Agriculture, N. D., and T. M. Thakor, Superintendent, Dohad Farm, with very satisfactory results. Out of 13 boys that appeared in each of the 1st and the 2nd year, 12 and 11 boys respectively got through successfully.

A sum of Rs. 300 was received as a contribution from the District Local Board, Panch Mahals. The total expenditure of the school during the year under report was Rs. 9,341-9-6, consisting of Rs. 3,407-14-0 for pay and travelling allowance of Establishment; Rs. 1,895-5-0 for boarding charges of the boys ; Rs. 2,661-10-0 for weaving and workshop materials and purchase of live-stock and implements ; and Rs. 1,376-12-6 for other contingent expenses. The receipts of the school amounted to Rs. 196-13-2 as against Rs. 10-12-3 of the last year.

Agricultural training, both practical and theoretical, to the boys of VI and VII standards in the Dharala Boarding School which adjoins the Godhra Vernacular Agricultural School has been introduced since the year under report.

15. *Vernacular Agricultural Education in the Bhil Boarding School at Dohad.*—The new classes began with 6 boys in the 1st year and 9 boys in the 2nd year. The annual examination of these boys was held by Mr. J. G. Naik, Head Master, Agricultural School, Godhra, in March 1923. The result was satisfactory, 4 and 7 boys passing respectively.

16. *Vernacular Agricultural School at Surat.*—This has been recently started near the Government Farm, Athwa Lines, Surat, as a trial for one year from 24th June 1923. A sum of Rs. 2,500 has been contributed towards its expenses by the Surat District Local Board. A full report will only be possible next year.

17. *Introduction of Agricultural Training in Primary Vernacular Schools.*—With a view to introduce Agricultural training in Vernacular Primary Schools, as an experimental measure, 5 vernacular trained teachers have been selected, one from each District in Gujarat, and kept for training in a special Agricultural course. for one year at the Vernacular Agricultural School, Godhra, from July 1923.

18. *Publication of Agricultural Matters.*—The publication of the Broach Quarterly Magazine was continued as usual, 27 articles in all being supplied by the Agricultural Staff in this Division.

Mr. M. L. Patel has further supplied material on South Gujarat Cottons which will be published as a memoir on "Studies in Gujarat Cottons, Part II." The researches on Jowar Stem-borer by Mr. Jhaveri are also being compiled for publication as a memoir.

IV. Propaganda Work.

19. *Divisional Board.*—As mentioned before in paragraph 3 the whole propaganda work in the District is now conducted under the guidance of the Gujarat Divisional Board of Agriculture which held in all three meetings for the purpose during the year under report, on 19th June 1922, 3rd October 1922 and 19th March 1923.

Some of the main business was, (1) the passing of rules, budget and programme of work of the Chorashi Taluka Development Association started on 18th June 1922; (2) controlling the grants under Agricultural Experiments and Demonstrations and Shows allotted for propaganda purposes; (3) passing the quarterly summaries of work done and approving the programmes of work to be done by the propaganda officers of the Agricultural and Co-operative Departments; (4) recommending registration of six Cotton seed and Sale societies newly started in Broach District during the year; and (5) disposing of various questions brought before the Board by its members.

The Divisional Board has been constituted as a Divisional Cotton Committee by the addition of two representatives from the cotton trade. This joint working of the Gujarat Divisional Board of Agriculture and Divisional Cotton Committee will be begun from July 1923 and it is expected the Committee will be very useful in tackling the cotton problems of the Division and forming a joining link with the Indian Central Cotton Committee, Bombay.

20. *District Cotton Work.*—There has been no change in the organisation and policy as regards the improvement of cotton in the Surat tract, except that as desired by the trade the whole tract south of the Narbada river is put under one strain of cotton, *viz.*, 1027 A.L.F., instead of two as in the past. Accordingly the cultivators of all groups were persuaded to grow 1027 A.L.F. During the year one new group constituting the villages of Vankaner, Afwa, Isroli and Siker was formed with the ginning centre at Bardoli. The total area under the control of the Department was 8,400 acres, and the cotton was ginned at the following gins:—

(1) Bamanshah Gin, Surat, (2) Messrs. Narandas Rajaram & Co.'s Gin, Sania, (3) Messrs. Whittle & Co.'s Gin, Bardoli, (4) Messrs. Tata & Son's Gin, Navsari and (5) Messrs. Dayabhai Ukabhai & Co.'s Gin, Sisodra.

The total quantity of *Kapas* ginned at these centres amounted to 66,120 maunds and the quantity of cotton (Lint) obtained from this was 1,072 Khandis (about 2,200 full pressed bales). The system of auction sales which worked so admirably well till last year, was not found suitable this season as cultivators preferred to sell their produce whenever they liked and did not care to wait for auction days. The merchants did not like the system as the cultivators did not part with their produce to the highest bidder when they considered the premium offered was less than that received in the previous years.

Again due to the wide spread distribution of pure seed during the past three seasons, the general quality of the produce of the district has improved very much. As merchants are able to obtain cotton of similar quality in the market, they are not inclined to pay the high premia which they used to give formerly. Under the circumstances the cotton was sold in the open market in 25 lots and the premium obtained varied from Rs. 15 to Rs. 30 per Khandi. Usually the consumers of such high class cotton are few; consequently sometimes in the market there is very little competition and the premium offered is not encouraging. It would be much better in the interest of the cultivators if a buying agency could be secured for purchasing the produce of the controlled area by paying a remunerative premium.

Cotton Seed Distribution.—The total quantity of seed purchased by the Department was 2,160,000 lbs. of which 1,680,000 lbs. were obtained from the controlled area and 480,000 lbs. of second class seed were purchased from reliable sources at Navsari and Maroli. The whole of the above lot was disposed of as under :—

	Lbs.
The Rajpipla State	720,000
The Nawapura Petha Mahal	240,000
The Baroda States (6 Depôts)	282,000
British Districts (9 Depôts)	918,000
Total ..	2,160,000

Besides the seed distributed by the Department, an enormous quantity of seed was distributed by two gin-owners who ginned the farm *Kapas* separately and gave out the resulting seed to their clients.

This is the fourth year since these operations were started and the results so far obtained are very gratifying. Almost the whole tract is now under farm seed and *goghari* cotton does not occur to more than 3 to 4 per cent. in the district. Till last year the so-called "Selection I A

was distributed in the tract North of the river Tapti; but as it has been proposed to extend "1027 A.L.F." up to the river Narbada, it is necessary to carry on these operations for some years more yet, so that the whole area may be under one uniform strain, and it is hoped that with the passing of Cotton Transport Act the work will be more easy.

The quality of cotton produced in Ankleswar and Rajpipla has considerably improved and many large firms opened agencies there during the season for purchase of that cotton. Though the ginning outturn of farm *kapas* was low (2,640 lbs. of *kapas* required to produce 1 *khandi* of lint against 2,400 lbs. of the local), the rates obtained were so compensatory that the merchants were able to pay Rs. 5 more for the farm *kapas* to the growers. This applies even to Rajpipla cotton which has had a bad reputation hitherto.

In all Rs. 75,000 were advanced by the gin-owners to the cultivators as usual at 6 per cent. interest, and Rs. 1,04,000 were advanced by the Director of Agriculture from his Personal Ledger Account for financing the seed purchase and distribution operations. During the year two meetings of the local Cotton Committee were held for settling the ginning charges and discussing the proposed Cotton Transport Act.

21. *Agricultural District Work.* (*a*) *Demonstrations and Shows.*—During the year under report 15 big and small demonstrations and shows were held—two in the Surat District (including the Dangs), two in the Broach District, three each in the Kaira and Ahmedabad Districts, and five in the Panch Mahals. The successive demonstrations at Ahwa in the Dangs for the last three years have impressed enough on the minds of the Dangis and they have begun now to take an interest in introducing improvements in their methods of agriculture. The greatest difficulty for giving them constant advice and help from this Department was the want of a suitable fieldman who could stay permanently in the Dangs. To get rid of this hitch, a Bhil boy from Dohad has been specially kept for training at the Vernacular Agricultural School at Godhra from June 1923, who after completion of his training will be posted in the Dangs permanently for agricultural propaganda work.

(*b*) *Implement and Seed Depots.*—The depots at Godhra, Dohad, Jhalod, Kalol and Prantij were continued and the one at Aslali was closed in October 1922. The depot at Bulsar was reopened from 1st July 1922. Emplements were issued free of charge for trial, resulting in a requisition for two C.T. 2 type ploughs. Implements and spare parts worth Rs. 216-12-0 were sold from the Aslali depot, while the hire charges earned by all the other depots amounted to Rs. 55-0-6 only.

(*c*) *Distribution of Seeds and Implements.*—Apart from the special organisation previously described for cotton seed in the Surat and Broach districts, various kinds of seeds were distributed from the different farms and by the District Agricultural Overseers, the total quantity of which

came to nearly 64,118 lbs. of which 35,267 lbs. were cotton seed, 6,160 lbs. wheat and 14,680 lbs. *San hemp* seed, and the remaining miscellaneous seeds of various kinds of groundnuts, vegetables and fruit trees. 133 implements mostly ploughs and their spare parts worth about Rs. 1,140 were distributed.

(*d*) *Demonstration Plots.*—The District Agricultural Overseers managed 203 demonstration plots covering an area of 260 acres on cultivators' fields to demonstrate various varieties of crops and methods of tillage recommended by the Department.

(*e*) *Measures to prevent Smut in Jowar.*—In all 6,020 packets of copper sulphate were distributed in the Division.

22. *Agricultural Co-operative Propaganda.*—In all there are eighteen Co-operative Non-credit Agricultural Societies in Gujarat; of these six are Co-operative Cattle Insurance Societies and the rest Co-operative Cotton Seed, and Sale Societies. The efforts of the Organiser are now chiefly directed to the formation of Cotton Sale Societies and during the year under report six new societies were registered of which three began actual working. It is hoped to put the remaining Societies in working order next season and efforts will be directed to the formation of new societies.

The Sonsak Co-operative Cotton Sale Society which is working since last four years has made admirable progress. It has now 220 members and during the past season it ginned nearly 1,100 *bhars* of *Kapas* and the value of lint and seed sold amounted to Rs. 3,15,000. The Islampur Society in Jambusar Taluka, though only registered this year, has been really working for three years and during the season under report it ginned nearly 1,000 *bhars* of *Kapas.*

23. *Insect and Other Pests.* (*a*) *Katra or Hairy Caterpillars.*—(*Amsacta moorii*).—This is a very destructive pest to young growing crops on the goradu soils of North Gujarat, and during the year under report efforts were made to control it at Dohad in the Panch Mahals District and at Anghadi in Kaira District by dusting the crop with Paris Green and lime mixture in the proportion of 1 in 20. Few caterpillars ate the dusted crop, but they left dusted area. The virulence of this pest lasts for nearly three weeks and as light showers which are very frequent during this period wash off the dust, this makes a difficulty, but as a protection the method seemed completely effective. These experiments are proposed to be further carried on next season, in order to see whether the necessity of frequent dusting can be removed.

(*b*) *Granary Pests.*—The use of Carbon Bisulphide as an insecticide for granary pests was demonstrated in some places in the District and about 20,000 lbs. of various sorts of seeds were treated. The effective dose for controlling these pests is one ounce of Carbon Bisulphide for 200 lbs. of seed.

(c) *Wild pigs and Jackals.*—About 800 packets of Strychnine Hydrochloride and White Arsenic were distributed throughout the Division for poisoning trials on wild pigs and jackals. From the available reports received it was observed that about 40 per cent. of the baits were swallowed by the wild animals and 95 per cent. of the animals who swallowed the baits died. The people who tried these baits generally report that the damage from these pests was checked and the result was satisfactory.

(d) *Jowar Stem-borers.*—Mr. Jhaveri, who is working as a Special Entomological Officer, continued his researches on these pests as reported in last year's report and the results of his researches are being compiled as a memoir for publication.

24. *Boring.*—According to the devolution scheme 14 machines were allotted to this Division and were taken charge of in February 1923. Of these one Musto Power machine and one Calyx Hand Machine have been lent to the Kaira District Local Board on certain conditions. So only twelve machines remained with the Boring Assistant of which one is a Musto Power machine, two Musto Hand and nine Cawnpore type machines. The Cawnpore machines are not efficient to work below 100 feet depth and as water level has gone very low borings have usually to be made deeper. Moreover, in Panch Mahals and Surat Districts rock is met with and work is handicapped as there are only three effective machines to work with. It is desirable to have more effective machines such as Musto patent and Calyx Drill, so that the boring work may be pushed on in Ahmedabad, Panch Mahals, Broach and Surat Districts where comparatively little work has been done in this line.

Owing to the recent flat charges rules passed by the Government, by which Rs. 5 per foot are to be charged in addition to the usual charges irrespective whether the bore is a success or a failure, the amount of work done during the year has been much less than was expected. It is hoped the new rules which are now proposed will give some relief to cultivators, although they feel even these rates more heavy than those of the Local Boards.

During the year under report 17 bores involving a total depth of 779 feet were undertaken; of these 11 were successful giving 25,000 gallons of more water; two were abandoned and one was a failure and 3 bores were incomplete. Two old bores which were chocked up were cleaned and set right. There were no serious accidents in the working during the year.

25. *Mechanical Assistance to cultivators.*—One of the Mechanical Assistants hitherto working under the Agricultural Engineer was attached to the Gujarat Division from February 1923. His chief duties are to advise the cultivators in the erection and repairs of pumping and other agricultural machinery. Six applications for advice on the erection of pumps, etc., were received. He inspected two sites for pump erection at Tukwada and Vavli at the request of the owners and gave them necessary estimate and advice. There are a number of pumping plants

in working in North Gujarat, and it is hoped cultivators will be much benefitted by his advice. Steps are being taken to advertise this to the cultivators in the Division.

It was proposed to take the Case Tractor belonging to Messrs. Polson Manufacturing Company of Anand on hire by the Department for ploughing lands of cultivators in Broach District where there was a keen demand for the same. Before taking the Tractor on hire, Mr. Vaidya was asked to take its trials. After several repairs with great difficulty he was able to put the Tractor in working order in the beginning of July 1923. After the rains are over, the trial of the Case Tractor will be taken in the Surat and Broach Districts and if found suitable it is hoped private Agencies will take up the work.

Surat, 21st August 1923.

(Signed) BHIMBHAI M.,
Deputy Director of Agriculture,
Gujarat, Surat.

APPENDIX F.

Summary of work done by the Deputy Director of Agriculture, Konkan, during the year 1922-23.

General.

1. I continued to be in charge of the division throughout the year.

2. *Lines of work.*—The work of the year 1922-23 has proceeded and developed along the same main lines as in the past. The following are the most important features of any changes in the detailed organisation and equipment of those main lines.

Encouraged by the success achieved in evolving substantially higher yielding strains of *Kolamba* rice for the North Konkan at the Karjat Rice Breeding Station, breeding work for South Konkan has been taken up at Ratnagiri on the existing Ratnagiri farm since the end of the year under report.

The experimental work in rice and other subsidiary crops of rice lands on the Ratnagiri farm having been carried on to sufficiently conclusive results has been discontinued, it being contemplated to go further deep in the problems of the increase in the yield or bringing about an economy in rice cultivation at the Karjat Rice Research Station.

The administration of well-boring for cultivators was transferred from the control of the Agricultural Engineer to that of the territorial Deputy Directors of Agriculture from the 1st of February 1923.

3. *Staff.*—The strength of the superior technically educated staff of assistants stands as follows in comparison with the last year:—

	1921-22.	1922-23.
Research and Experiment	.. 8	8
Extension and Propaganda	.. 5	5
Agricultural Education	.. 2	1
	15	14

4. *Cost of the year's work.*—The following statement will furnish the information in abstract for each broad division of activities.

Class of work.	Establishment (pay and allowances).		Contingencies.		Total.	
	1922-23.	1921-22.	1922-23.	1921-22.	1922-23.	1921-22.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Research and Experiment ..	18,317	22,178	17,982	37,263	36,299	59,441
Extension and Propaganda ..	16,161	18,346	4,825	4,682	20,936	23,028
Agricultural Education ..	5,294	5,747	10,027	19,209	15,321	24,956
Direction and Superintendence.	17,310	13,204	1,796	1,995	19,106	15,199
Total ..	57,082	59,475	34,630	63,149	91,712	1,22,624

It will be seen that the total expenditure has been reduced down by over 25 per cent. as compared to last year. This is due to the abolition of the experimental farm and the Agricultural School at Alibag and retrenchment of contingent expenditure on the Ratnagiri and Kumta Farms by getting the demonstration part of cultivation on these farms done by cultivators as sub-tenants.

5. *Physical and other conditions influencing the agriculture of the year.*—The rainfall and season was not the most favourable. The most important characteristics which have affected the yields of rice, by far the most important crop of Konkan, more or less adversely, were, holding off of rain in the seedling stage and heavy falls on the ripe crops in the North Konkan, which sprouted and spoiled the grain. In Ratnagiri, sprouted seed sowings were delayed and subsequent heavy rains checked the growth and are supposed to have washed away the fertility of the fields resulting into decreased yields upto 50 per cent. Rain in September and October was quite insufficient except in below-ghat Kanara and was responsible for a part of the decrease in the yields. On the whole the net effect of the season was a decrease in the yield of rice by 20 to 30 per cent. over a normal year. Rabi season may be said to have been generally favourable.

In regard to pests and diseases, those worth a special mention as occurring in addition to the usual ones are, a mild attack of rice stem borer in Ratnagiri and a very severe attack and loss by *Koleroga* on betelnut in Kanara amounting to 50 per cent. or more. The wild pig trouble is on an increase in the Kolaba and also in parts of the Ratnagiri districts.

Research and Investigation.

6. *Researches into the increasing of yield or bringing about an economy in Rice Cultivation.*—The physiological factors which contribute towards making up the yield, and the best and the most economic ways to influence their best action have been under an intensive and exhaustive study at the Karjat Rice Research Station for the last four years. During the year of report, the rice work at the Ratnagiri and Kumta experimental farms was remodelled so as to afford data for verifying the most important points determined at Karjat under quite different sets of conditions of soil and climate representative of the laterite Konkan.

Judging of the results in respect of practical value, they corroborate the previous observations that there is not much room to increase the yield of the crop by modifying the cultural details such as age and robustness of seedlings at transplanting, number of seedlings planted per bunch, space allowed per bunch, degree of puddling, etc., and that the present practices of cultivators are very near those that could be recommended as a result of the research work; and that the principal and the most powerful means of increasing the yield lie in the direction of increasing the proper nourishment of the plant by either manuring or by adequate water supply and drainage.

In regard to manuring, the remarkable and ruling influence of the addition of nitrogen and insignificant effectiveness of the addition of

phosphoric acid in the form of mineral superphosphate on the trap soils may now be declared to be almost conclusive. On the laterite soils represented by Ratnagiri and Kumta, however, phosphoric acid in the more inert forms of bone-meal and rock phosphate show considerable effect, while nitrogen as sulphate of ammonia is altogether without any effect unless accompanied by farm yard manure at Kumta. The increase upto nearly doubling the crop with the addition of 60 lbs. of nitrogen in the form of sulphate of ammonia in the trap soils represented by Karjat is maintained. Similarly on the laterite soils represented by Ratnagiri farm the ordinary crops which have been about half of the average owing to unfavourable season, have been also doubled by manures supplying upto 100 lbs. of nitrogen in the form of *undi*-cake. On soils represented by Kumta, however, the increases have at most gone upto 50 per cent. even with large doses giving upto about 100 lbs. of nitrogen in the form of sulphate of ammonia in addition to farm yard manure, over the local treatment crops, which, unlike North Konkan and Ratnagiri receive a good quantity of leaf compost.

Comparing the various forms of manures in which nitrogen or the other plant foods could be supplied, although it has not yet been possible to make a comparison of all in several increasing doses, *rui* leaves and cowdung are nearly as effective as sulphate of ammonia at Karjat, bone-meal manure even in lower doses upto 4 cwts. and *rui* leaves upto 8,000 lbs. of green matter per acre have at Ratnagiri brought about increases of about 50 per cent. on low lands and nearly cent per cent. on the poor uplands, at Kumta bone-meal upto 6 cwts. per acre has been responsible for an increase upto 60 per cent. and 2 cwts. of rock phosphate, 25 per cent. The higher doses of these manures except sulphate of ammonia at Karjat give much less return quantity for quantity, and thus the higher quantities are not generally paying.

Water supply and drainage appear to be as powerful a factor in affecting the yield of rice, as direct manuring. If the yields of rice over a series of years under natural conditions in the results of the experimental farms in Konkan be examined, it is most striking that they have varied with very large margins amounting to 50 per cent. or more. The difference in water supply and drainage must be responsible for this. Investigations have been started since the year of report to clear up this very vital problem.

7. *Selection and breeding of higher yielding strains of rice for South Konkan.*—Encouraged by the success achieved in evolving substantially higher yielding strains of *Kolamba* rice for the North Konkan at the Karjat Rice Breeding Station, breeding work for South Konkan has been taken up at Ratnagiri on the existing Ratnagiri farm since the end of the year under report.

As a preparation for the first operation of obtaining a large number of individuals of known parentage, bulk samples have been collected from the various parts representing the Ratnagiri and Kanara districts constituting South Konkan, for being grown in the ensuing rice season.

8. *Remedial measures against rice land Crabs.*—The land crab is responsible for a very great direct and indirect damage in the North Konkan, and also in Sind, and the study of the pest and remedial measures against it has been taken up from the year under report as requiring the first attention amongst several other zoological problems of the Konkan. During the year under report, the number of species has been determined and identified and the seasons of activity and hibernations, the general habits of living, digging burrows and feeding, distribution under the various soil and climatic conditions also formed the subjects of investigation as much as could be done within the limitations of time and funds available. The nature and amount of direct and indirect damage done to the rice crop was estimated.

As regards remedial measures, nothing being known about the life history much could not be done in this respect. However experiments were made in the laboratory and some of the substances like slaked lime, lime carbide, crude oil emulsion, *adulsa* (*Adhatoda vasica*) leaves were found to be useful. Trapping young ones and pumping in the burrow, poisonous fumes of lime carbide and others were also tried in the fields without much success.

Selection and breeding of higher yielding strains of Nagli.—This work is being done at Hatkhamba, 10 miles east of Ratnagiri. The year of report is the second of taking up this work. A large number of individuals selected and marked out of a crop of bulk samples of the previous year as suitable material for further determinations and isolation were grown separately. All these were dealt with with the usual plant breeding methods and as a result about one dozen strains which have given 100 per cent. and over increased yield in comparison with one of the two varieties commonly grown locally have been discovered. Forty more strains, which have given yields between 60 and 100 per cent. more than the local seed, have also been kept for being repeated with a view to give a chance to any of them which might have failed through some environmental cause to come upto the standard of 100 per cent. and more yield during the last year but which may conspicuously come to the front in future. This work is thus exceedingly promising.

9. *Remedies against Blight disease of Onion.*—The appearance of this disease during the last some years after the successful introduction of this new and profitable crop in South Konkan is preventing its further extension and is also threatening its abandonment in the places in which it is already introduced.

The investigation of this disease and into remedial measures has been taken up for the last two years by the Plant Pathologist to Government in collaboration with the staff of this division. This year the disease has not been so virulent as in some years. Spraying with Burgundy mixture fungicide has had no beneficial effect, manuring with some readily available nitrogenous concentrate such as nitrate of soda to the seedlings

and the transplanted crop enabled the crop to resist the disease much longer than without, while a crop on burnt land on the Ratnagiri farm had hardly any disease. Planting in rows, although getting the disease, at the same time and of the same intensity as irregular and thick planting in beds, seems to help the earlier development of bulbs and to thus give a larger outturn per acre. Out of the several varieties tried, Goa is the most resistant, then coming Alibag and Palghar.

10. *Bone-meal manure for Vaingan (irrigated winter) rice in North Kanara.*—This was tried during the year by the Agricultural Overseer, Kanara, at six places on cultivators' fields. The results show on the whole that the manure benefits the winter crop as much as the *Kharif* crop.

11. *Comparison of bone superphosphate with raw bone-meal for rice.*—This was done on cultivators' fields at half a dozen places in Kolaba, Ratnagiri and Kanara districts. The superphosphate did not show any advantage over the raw form anywhere.

12. *Bone-meal as a corrective of salt affected sweet rice lands.*—One of the several applications of bone-meal manure for rice in the general propaganda by the Agricultural Overseer, Kanara, chanced to be on the above described soils, which resemble the *morik* character noticed at Shiroda in the Vengurla taluka of the Ratnagiri district. The corrective effect was most astonishing, resulting in an increase by 150 to 200 per cent. in a crop which without bone-meal manure dries up in patches and is stunted with very small ear-heads.

13. *Maskati variety of paddy for vaingan (irrigated winter), rice.*—This was tried on four cultivators' fields in Kanara, at three places it did better than the local kind with the additional appreciation for white grain for clean and par-boiled rice.

14. *Testing of the use of concentrated manures and new varieties of sugarcane in Kanara.*—A top-dressing of concentrated manures, such as sulphate of ammonia, fish manure and oil cake has been conclusively proved to be substantially profitable both on the Kumta farm and in the trials in the district.

In point of new varieties, the Kumta farm trials of the year put up the Red Mauritius by far the best. The " B.-208 " which stood superior to any others tried during the previous three years has gone down very much on the Kumta farm during this year. The trials by the Agricultural Overseer, Kanara, in the above ghat portions show that Red Sport is very promising, it ripens early, is soft for milling and gives a better coloured *gul* than *Red Mauritius*, the softness of this, however, gives it a certain disadvantage in that it is more susceptible to damage by jackals and pigs.

15. *Economising the cost of supporting sugarcane against lodging by the use of wire.*—Mr. V. S. Habbu, Superintendent, Kumta farm tried iron wire of 1/12 inch thickness stretched on vertical poles at every 50 feet to which standing cane is to be tied and found it to save the cost by half of that required by the local practice of using bamboos.

16. *Nitrate of soda and sulphate of ammonia for melons.*—These were tried by the Agricultural Overseer, Kolaba, near Karjat (Kolaba district)

in comparison with the local practice of giving fish manure, at the rate of 120 lbs. of each. Nitrate of soda could not compete with fish manure, but sulphate of ammonia did so most successfully in that it gave the same yield as fish manure but caused a saving of Rs. 45 per acre in the cost of manuring with fish (Rs. 75) even at this year's cheap rates for the latter.

17. *Nitrate of soda on garden crops of plantains, betelvine, etc.*—These trials were made by the Agricultural Overseer, Kolaba in private gardens in the Thana garden tract. Ten cwts. application in 12 monthly doses to betelvines fell short of the local manure by about 25 per cent. in the estimation of the owner, but with plantain the results were very remarkable. The total quantity of 5 cwts. of nitrate of soda and 1 cwt. of double superphosphate given in 2 monthly instalments at a cost of Rs. 100 produced no less a crop in quantity and quality than the local practice of manuring with 10 *khandis* of castor cake at a total cost of Rs. 300.

18. *Experiments in increasing the yield and profits from cocoanuts in Konkan.*—A study of the existing methods of cultivation has been made for publication. Common salt for manuring is being tested at Ratnagiri and Kumta for the last year. It is too early to draw any results. The Agricultural Overseer, Kanara has tried certain green manure plants in private gardens and found *Crotolaria striata* to grow to a height of six to eight feet and to give a good quantity and quality of green matter. *Tephrosia* also does well and stands pruning but it is liable to wilt.

19. *Making holes for mango planting in laterite rock by farm dynamites.*—Trials on a private planter's land at Ratnagiri carried on a fairly extensive scale showed that with a charge of 5 cartridges (Nobels farm explosives 4" dynamite and gelignite) put in a slightly slanting bore nearly 3 feet deep, pits two to two and a half feet deep and equally wide could be formed after removing the blown up and shattered debris. These dimensions of pits were considered enough by the owner. The value of these pits for planting mangoes is further enhanced by the fact that compactness of the rock round the pits and at the bottom is shattered through, making the way easier for the penetration of roots. The cost came to about Rs. 2 per pit which compares favourably with Rs. 4 to 5 for hand digging one of 3 feet in all dimensions.

20. *Bourbon tree cotton on varkas lands in Ratnagiri.*—Plants growing luxuriantly and yielding a good crop of cotton are noticed in house yards almost everywhere in the South Konkan. A few trials on plantation scale made by some private gentlemen in the Ratnagiri district have met with partial success although they were eventually abandoned by the experimentors as they could not devote sufficient attention owing to other professions, in which they were engaged. There is, however, every reason for hoping that Bourbon cotton plantation may be a success in the laterite Konkan. A beginning has therefore been made on hill slope on the Hatkhamba *varkas* land Experimental Station during the year under report. The plants stood well and grew to a height of one foot by the end of the last monsoon, dropped their leaves in the dry season but have shooted again vigorously at the break of the next monsoon.

21. *Wheat in the North Konkan.*—This is being tried at Jambul under irrigation for the last two years. The year's results confirm those of the previous one that wheat is very much susceptible to rust in Konkan but that *khapli* variety does not get it to the same extent as *bakshi*. Pusa No. 4 which was tried in addition this year has been almost resistant and has given a fair crop of 1,100 lbs. per acre with 746 lbs. for *khapli* and almost a total failure of others tried.

22. *Tobacco on the Kumta farm.*—In the second year's trial of the Malbar varieties this crop has been subject to a leaf blight disease as against the first year's splendid success, necessitating further trials to arrive at definite conclusions.

23. *Jowar for fodder as a rabi crop in rice lands.*—This has been a second time found to grow well near Karwar.

24. *Algaroba.*—(*Prosopis juliflora*) *as a fodder plant.*—At the instance of the Director of Agriculture, Bombay Presidency, this plant has been tried at Kumta and Ratnagiri with special treatment. The seeds that germinated at each place are thriving well at Ratnagiri attaining a height of 6 feet, while at Kumta farm they are doing just fair.

25. *New fruit trees in coastal Kanara.*—Several new fruits are being tried. Oranges and *Musumbis* have been thriving well and the latter has borne the first crop of fruit. *Alphonso* mangoes have also commenced bearing since the fifth year after planting.

26. *Crops new to the Mundgod tract of the Kanara district.*—Cabbage, knolkhol, potato, onion, tomatoes, chillies, brinjals *karle, dodka, bhendi, gavar*, cucumber, sweet potato, groundnut, cotton vari, sesamum, tobacco, *chiku*, oranges, guavas, pomelo were tried. Most of the vegetables did well as should be expected. Kumta cotton grew well. Groundnut did fairly.

27. *Improvement of Manat lands of North Konkan.*—The year's work has confirmed the results of the previous years and has added nothing to them. The small improvements so far made not having met the practical appreciation by the people and on account of the general conditions of agriculture having been such that even all the good rice land cannot be properly cultivated, it would not be of any use to proceed on with these experiments. They have, therefore been closed by the end of the year under report.

28. *Improvement in Implements.*—The introduction of a bar share point in the Meston plough on the Kumta farm has been found to do better penetration and save the expenditure on the replacement of shares very frequently. The Deccan blade harrow has been now conclusively proved to be an effective and economical implement for preparing a puddle for transplanting rice. A smaller size (15 to 18 inches) of blade is necessary to suit Konkan cattle.

29. *Oven drier for drying the garden produce in Kanara.*—An experimental oven has been constructed out of stone and mortar at Killar in the Siddapur taluka of the Kanara district with suitable drying chambers. Plantains can be dried within 12 to 16 hours requiring about 50 lbs. of dry fuel (worth annas two), for a full charge of 1,200 plaintains. Sun-drying

requires one week and no drying or transporting to market being possible during the rainy season the produce of that season almost goes to waste. Betelnut drying was also tried with success on the same machine. The oven as tried has, however still many defects, which do not give uniform heat at all places in the chamber. These will be remedied in further experiments. Mr. G. R. Hegde of Hirekai, Siddapur taluka is trying a steam heating drier with success on a small scale. He would be subsidised for carrying out further experiments.

30. *Best way of utilising bare minor forest areas for supply of leaf manure in Kanara.*—This is the second year of the experimental plantation made at Kumta. Local practices have been studied and recorded. About 25 species inculding quick growing shrubs as well as slow growing large trees have been planted and are growing. It is too early to say which would be the best in all respects. The Agricultural Overseer, Kanara, in his trials on cultivators' fields has found that *pithecolobium* seedlings grow fast attaining a height of 5 to 6 feet in three years and give good foliage.

The attempts to establish a *rui* plantation on *varkas* lands in Ratnagiri are proceeding. In addition to the cuttings being successful for this purpose, fresh seeds have been also found to germinate very well.

31. *Destruction of wild pigs and other wild animals by poisoning.*—Strychnine has been found very effective. To ensure killing within a furlong or two a dose of eight grains is necessary for a wild pig. The most successful bait for wild pig is fried bran in which balls prepared out of fried flour and *gul* about the size of a pealed betelnut with the poison introduced inside it through a hole to be made subsequently and closed with unpoisoned stuff, should be kept. The best bait for jackal is fish with poison introduced inside by splitting its mouth longitudinally.

32. *Protection of cabbage and knolkhol seedlings from flea beetles and other insect pests.*—Mr. P. V. Wagle, Entomological Assistant, Konkan has found that cruciferous seedlings which are so liable to devastation by insects can be very successfully protected by a screen of muslin cloth all round the seed-bed at a cost of Rs. 28 per acre, which will last for about four to five years. Similarly he has found that flea beetles on them can be successfully trapped and checked by drawing over the seed beds a tin channel pasted with a mixture of some thick oil such as *undi oil* (*colophyllim inophylum*) and rosin at a cost of annas 12 for seedlings sufficient to transplant one acre.

Extension Work.

33. Extension work consists in bringing agricultural improvements to the notice and into the practice of agriculturists and giving such advice and help as will make the agricultural industry in general more profitable. This work is principally carried on through the itinerant district staff who are called Agricultural Overseers, assisted by Kamgars. The Agricultural stations also serve as standing centres of demonstrations or as centres for distributing improved seed, manures and implements.

The Divisional Board consisting of a majority of non-official representatives of agriculture and co-operation that was established for the Konkan Division at the end of the previous year directed and controlled the policy of the propaganda work. Three quarterly meetings were held for the purpose during the year.

The work in the Thana district had to be suspended as the incumbent of the post of the Agricultural Overseer was still on long leave owing to ill-health and no trained substitute was available. The work in the Ratnagiri district was similarly dislocated owing to the permanent incumbent being required to go on six months' leave on account of ill-health and his charge being temporarily held by quite a raw man, yet undergoing training. The work in other districts has continued unhindered by any such circumstances.

The propaganda of spraying against *Koleroga* disease of betelnuts and the organisation of non-credit agricultural co-operation and of well-boring for agriculturists in the Konkan Division have also been transferred to the control of the Deputy Director of Agriculture, Konkan, through the Divisional Board.

Efforts are being vigorously made to stimulate Taluka Development Associations in areas which are ripe and ready to take up the work of Agricultural improvement on their own shoulders.

34. The detailed items of improvements proved to be worth introducing, which have formed the activities of the year are mentioned below by each district, the sphere of operations which it has been possible to tackle being indicated in brackets under each district.

Thana District.—(Chiefly round Palghar and in the Kalyan Taluka).

(1) Improved strain of Kolamba Rice ; (2) Nitrate of Soda for onions ; (3) Silage. A full programme could not be undertaken owing to administrative difficulties.

Kolaba District.—(Chiefly Ulhas and Patalganda valleys).

(1) Stimulation of irrigation farming on the Tail waters of the Tata Hydro-electric works, together with all improvements possible ; (2) substitutes to meet the deficiency of rab for rice ; (3) Mass selected rice seed ; (4) Improved Kolamba strains of rice ; (5) Bone-meal manure for rice ; (6) Nitrate of soda for onions.

Ratnagiri District.—(Chiefly Ratnagiri, Sangameshwar and Devgad Talukas). (1) Substitutes to meet the deficiency of rab for rice ; (2) Bone-meal, fish and sulphate of ammonia manure for rice ; (3) Mass selection of rice seed ; (4) Deccan Harrow for Puddling rice fields ; (5) New profitable crops of sweet potato and kharif chillies on warkas land ; (6) Guinea grass on warkas lands ; (7) New and profitable crop of onions ; (8) Extension of sugarcane cultivation ; (9) Poisoning of wild animals doing damage to crops ; (10) Meston plough ; (11) Bulsar Rahat water lift and mot ; (12) spraying against mango hoppers ; (13) Improved breeds of poultry ; (14) Silage ; (15) Surti buffalo bull at Ratnagiri.

Kanara District.—(All over the district except Haliyal taluka). (1) Mass selection of rice seed ; (2) Bone-meal manure for rice ; (3) Mascaty variety of rice ; (4) Planting fewer seedlings ; (5) Red Mauritius variety of sugarcane ; (6) Use of concentrated manures such as Sulphate of Ammonia, Fish manure and Undicake for sugarcane ; (7) Wider planting and more efficient and economic tillage by sabul plough ; (8) Improved mills furnaces and Pans ; (9) Groundnut or maize and hakkal lands ; (10) Varri on hakkal and kumeri lands ; (11) Onion cultivation together with top dressing with concentrates ; (12) Tobacco cultivation ; (13) Guinea grass in gardens ; (14) Meston plough ; (15) Improved Rice Land Puddler ; (16) Use of undicake as manure instead of fuel ; (17) Pig proof wire fence. Poisoning of wild animals and organisation of communal watching for the protection of crops from wild animals ; (18) Silage in East Kanara ; (19) Surti buffalo at Kumta.

35. Methods of bringing these improvements to the notice and into the practice of agriculturists consists in inducing some leading cultivators at various places to try our recommendations on their fields with a guarantee if that there be any loss by our recommendation, it would be made up at Government cost. Very frequently the additional cost involved in our recommendation has to be incurred by the Government for the first time as the people are not willing to invest on anything until they have seen with their own eyes the economic advantages near their homes. Such plots and persons form the nucleii for bringing the results to the notice of others in the neighbourhood for which special occasions of explanations and demonstrations are arranged by the propaganda staff as much as possible. Preaching and propaganda is carried on by the Departmental propaganda staff in the neighbourhood of these plots, and more and more persons are induced to adopt the improvements. It requires great persistence and constant vigilance and attendance to get the recommendations carried out in the initial stages of the introduction of anything. The progress is necessarily very slow. Mere preaching or distribution of written matter cannot be of much effect beyond a preliminary preparation and all the time, at which there will be no occasion for occular demonstration work, is devoted by the propaganda staff in carrying out the general propaganda. Enquiries are also received from the public to a certain extent by correspondence and to a small extent by personal visits which are replied to by correspondence. The volume of work done is indicated by the fact that there were 74 demonstration plots in Kanara during the year, 19 in Ratnagiri, and 23 in Kolaba during the year, which were in almost all cases the centre of vigorous work.

36. Striking progress has been shown during the year in the introduction of the following improvements. In Kanara Red Mauritius variety of sugarcane, improved sugarcane mills, Poona pans and furnace and onion cultivation have now taken a firm root after the last ten years' work so that there will be no going back in them. Bone-meal manure for rice and concentrated manure for sugarcane, which have been taken up recently, show a hopeful advance.

In Ratnagiri, sugarcane cultivation is attracting more and more attention of farmers as it is becoming evident to them that much higher yields and profits are possible by adopting improved methods of cultivation, manuring and manufacture. This as well as other improvements are not progressing in this district as well as in some others, on account of the uneconomic and excessively fragmented holdings also on account of the fact that labour in Bombay affords a far more remunerative and far less risky occupation than agriculture.

In Kolaba, there is reason to hope that the perennial supply of water from Tata Hydro-electric works in the Western Ghats would be more and more used though in very gradual steps. The improved strain of *Kolamba* rice has been put out on an intensive and comprehensive scale for the first time in the Karjat taluka and Khalapur peta, and the next annual report would give us an exact idea about its future.

In the Thana district, where work has only been possible by fits and starts on account of the lack of continuity of the staff, row and ridge planting of vegetables and use of labour saving implements for ridging and interculturing is the one achievement that has taken a hold.

37. *Arrangements to supply implements, manures, seeds and other articles.*—In order to meet the demands which are created as a result of the propaganda work for articles which are not an ordinary market commodity, the organisation of sale and hire depots and free agency work for arranging supply of others direct from the firms were continued. Bone-meal manure, sulphate of ammonia, Meston plough, Poona sugar boiling pans and sugarcane mills were the most important of the articles thus dealt with. Arrangements to supply denaturalised salt for manurial purposes duty free were continued. Government have fixed a rate of annas thirteen per Bengal maund for three years up to 1925-26 even though it may cause some loss in the transanction. The number of permits issued together with the total quantity of salt for each district during the year under report is given in the following statement.

Period.	Thana District.		Kolaba District.		Ratnagiri District.		Kanara District.	
	Number of permits.	Quantity issued.	Number of permits.	Quantity issued.	Number of permits.	Quantity issued.	Number of permits.	Quantity issued.
		Mds.		Mds.		Mds.		Mds.
November issue	1	5	1	10	23	433	17	177
April-May issue	6	175	1	30	28	695½	26	221
Total for the year 1922-23.	7	180	2	40	51	1,128½	43	398
Total for the year 1921-22.	6	137	2	160	52	1,319	51	551

38. *Well Boring for cultivators.*—The organisation for well boring for cultivators has been transferred to the control of the territorial Deputy Director from 1st of February of the year. Six Musto patent hand machines and one Calyx power drill have been transferred. There was a certain amount of dislocation of work during the first month or two before the transfer operations were complete. Three of the hand and one power machines were allotted to the Thana district where there has been the greatest success and demand for well-boring, while one hand machine has been allotted to each of the remaining three districts in which boring is yet in an exploratory stage. The following is a resume of the work done from 1st February to 30th June of the year.

District.	Number of machines.	Total footage bored.	Number of bores completed Successful.	Unsuccessful.	Number of bores incomplete.	Number of bores cleaned.	Putting up hand pumps.
Thana ..	4	504	4	2	6	10	5
Kolaba ..	1	153	*Nil.*	1	1	*Nil.*	*Nil.*
Ratnagiri ..	1	80	1	*Nil.*	1	*Nil.*	*Nil.*
Kanara ..	1	57	*Nil.*	*Nil.*	1	*Nil.*	*Nil.*
Total ..	7	794	5	3	9	10	5

In Thana, in a belt within 10 miles from the sea coast springs capable of giving 2,000 to 4,000 gallons per hour are tapped from a depth of 60 to 100 feet; the bore in Kolaba is not yet complete; in the Khed taluka of the Ratnagiri district only 300 gallons supply at a total depth of 80 feet was obtained in the one successful bore and in the Kanara district, the prospects are yet uncertain, the rock (granite) to be bored being exceedingly hard and not having many fissures.

39. *Popularisation and introduction of Agricultural Improvements through Localised Non-official Organisations.* (*a*) *Old type Agricultural Associations.*—All except two of the old type Agricultural Associations continued to be on the list but did little work except in the Ratnagiri District with Ratnagiri, Sangameshwar and Dapoli as taluka branches and Sirsi and Honavar Taluka Agricultural Improvement Committee of the Kanara District which have tried to do something in respect of the items recommended as suitable to them. The work turned out even by the latter however lacks in comprehensiveness and a uniformly continuous and systematic policy. The reason is that people have no confidence and cannot be induced to contribute sufficient funds to emply paid trained men to carry on their propaganda.

(*b*) *Taluka Development Associations according to the new Government Scheme.*—In order partially to remove the difficulty referred to at the end of the foregoing paragraph and thus to stimulate local interest and effort the Government of Bombay sanctioned during the year of report a scheme

by which local non-official organisations, that would be formed in areas not extending over more than one taluka which may be regarded by the Agricultural Department to have sufficient improvements for introduction will be given from Government funds a subsidy equal to half the total expenditure but not exceeding Rs. 1,000 per annum.

Four talukas, Ratnagiri and Dapoli of the Ratnagiri district, Alibag of the Kolaba district, and Sirsi of the Kanara district applied during the year for the formation of the Taluka Development Associations under the Government scheme and the Konkan Divisional Board have recommended the recognition of the first three, and the application of the last being received late in the year will be considerded in the meeting of the Board to be held in July. They have adopted a good programme and have applied to the Agricultural Department for the loan of trained men for their Shetki Kamgars' posts. The first of the Associations having been formed in January and others as late as April it is too early to know anything about their usefulness.

The propaganda staff (honorary as well as paid) of the Agricultural and Co-operative Department are stimulating other talukas where conditions are favourable.

(c) *Stimulation of Co-operation for promoting Agricultural Improvements.*—The Agricultural propaganda staff, are, side by side with individual persnasion, also on the look out for stimulating co-operative effort for promoting agricultural improvements. Some possibilities have been located and investigation and stimulation were carried on during the year, but none have yet resulted into actual formation to be mentioned in this report.

A special paid officer for stimulating, investigating and supervising agricultural co-operation for the districts of Thana, Kolaba and Ratnagiri, who was so long under the control of the Co-operative Department has been transferred since the year of report to the control of the Agricultural Department under the Divisional Deputy Director of Agriculture. A separate incumbent for the post was available from January. He has been able to achieve the following :—

(1) Collaborating with the Agricultural propaganda staff in the formation of the Alibag Taluka Development Association and in the preliminary arrangements for the stimulation of ones for Mahim and Kalyan.

(2) Formation of a Grain Bank at Chendhre (near Alibag), investigation into the possibilities of forming irrigation societies in the Alibag Taluka, out of which those at Goteghar and Chendhre are likely to materialize during the next year, and preliminary investigations into a Fencing Society at Bhisegaon (near Karjat).

(3) Inspection of Irrigation Society at Awas (Alibag taluka) and Manure and Cattle Breeding Societies in the Thana district. These have been in a stagnant or even depressed stage. Most of them have been stimulated to a revival.

(4) Liquidation proceedings against two societies.

(5) As the incumbent is quite new to this line he had to devote a good deal of his time to a study of the literature and practices of co-operative improvement.

40. *Propaganda through publications.*—Leaflets in English as well as vernaculars for free distribution containing new successful results of the Konkan Division to be recommended, drawn up during the year are as follows :—

(1) Increase in the yield of rice crop by mass selection of seed.

(2) Cultivation of sweet potato in Konkan.

(3) Saving of rice seed in Kanara.

(4) Use of Bone-meal manure for Rice.

The results upto 1923 in regard to the researches in increasing the yield or bringing about an economy in the expenses of rice cultivation have been worked up for a Memoir of the Imperial Department of Agriculture under the authorship of Messrs. K. V. Joshi and M. V. Gadkari.

The translation of the " Book of the Mango " into Marathi was completed by Mr. V. R. Sabnis.

Notes and articles were contributed to the various Agricultural Magazines by the members of the staff of which the principal ones are mentioned below :—

Subject of note or article.	Name of author.	Where published.
(1) Monthly notes of agricultural operations for each of the four districts.	Deputy Director of Agriculture, Konkan, assisted by the Farm Superintendents and Agricultural Overseers.	*Shetki and Shetkari, Konkan Sheti Samachar* and *Vakkaliganoo Vakkaltanavoo.*
(2) Trapping of cocoanut beetle.	V. G. Gokhle, Deputy Director of Agriculture, Konkan.	Agricultural Journal of India.
(3) A note on destroying wild pigs by poisoning.	V. G. Gokhle and G. B. Pandit, Agricultural Demonstrators, East Kanara.	Poona Agricultural College Magazines and also in the vernacular magazines mentioned under (1) above.
(4) Six-monthly progress reports of the work in respective charges.	G. B. Pandit and P. V. Wagle, Entomological Assistant, Konkan.	*Konkan Sheti Samachar* and *Vakkaliganoo Vakkaltanavoo.*
(5) Interculturing sugarcane in Mundgod.	G. B. Pandit ..	*Konkan Sheti Samachar.*
(6) Work of Kirloskar plough at Mundgod.	N. R. Gokhle, Kamgar, East Kanara.	*Vakkaliganoo Vakkaltanavoo.*

Subject of note or article.	Name of author.	Where published
(7) Uses of Rice ..	K. V. Joshi, Rice Specialist	*Konkan Sheti Samachar.*
(8) Lessons useful for Konkan from agricultural practices of China and Japan.	Do. ..	*Do.*
(9) Profitable manure for cocoanut.	N. V. Hanmante, Agricultural Overseer, Kolaba.	*Do.*
(10) Improvement of the colour of gul in Kanara.	K. L. Hegdekar, Kamgar, Honavar.	*Vakkaliganoo Vakkaltanavoo.*
(11) Flies and their relation to man.	P. V. Wagle ..	*Konkan Sheti Samachar.*
(12) Cultivation of lac ..	Do. ..	*Do.*
(13) How to protect cabbage and Knolkhol seedlings from free-beetles, Grasshoppers, etc.	Do. ..	Agricultural Journal of Indian and *Konkan Sheti Samachar.*
(14) Agricultural education of farmers.	J. N. Purandhare, Head Master, and Y. R. Lale, Assistant Master, Jambul Agricultural School.	*Marathi Shikshak and Konkan Sheti Samachar.*
(15) Saving of irrigation water to fruit trees.	V. S. Habbu, Superintendent, Kumta Farm.	Poona Agricultural College Magazine.
(16) Economy by the use of wire in the cost of supporting sugarcane.	Do. ..	Do.

The Konkan Agricultural Magazine.—The monthly Magazine in Marathi devoted exclusively to Konkan agriculture under the name " *Konkan Shetki Samachar* " commenced by Mr. Y. G. Gurjar of Alibag in the year 1917 and the editing of which was taken over by the Konkan Agricultural Department under the Editorship of Mr. V. L. Bhosekar, Superintendent, Ratnagiri farm, published very useful information for which Mr. Bhosekar and others who contributed and Mr. Limaye who published the same punctually deserve the best thanks.

Agricultural Education.

41. During the year under report there was only one agricultural school, namely, Jambul, near Kalyan, District Thana, for giving agricultural education of a primary nature through Marathi. The year under report is the sixth year of the school. The standards for admission and the course of studies remained the same as in the past.

The year opened with 25 boys, 20 in the second year class and 5 in the first year class. At the end of the year however there remained 20 students, 17 in the senior class and 3 in the junior class. Out of these

13 in the senior class and only 1 in the junior class passed in the examination.

The total expenditure of the school including teaching staff and free boarding expenses amounted to Rs. 13,017 and the total receipts to Rs. 3,830 as against Rs. 16,048 and Rs. 1,700 respectively of the previous year.

Out of 46 boys turned out successful from this school upto now 13 having just passed out have nots ettled in life yet ; 7 are managing their own land, 7 are in service connected with agriculture, 4 are continuing ordinary secondary education, 13 are engaged in business other than that of agriculture and whereabouts of two are not traceable. Those that are engaged in farming have not as yet exhibited any striking development to justify their education at this school.

The school does not seem to be appealing as useful to the agriculturists, as in spite of propaganda done through the Revenue authorities and through the Head Masters of primary Marathi teachers of schools teaching fourth standard and above and through members of the propaganda staff of the Agricultural Department and the members of the Jambul Agricultural School staff taking special advertising and recruiting tours in the vacation and through demonstrations given by bringing to the Jambul School parties of primary school teachers with prospective pupils and guardians . There is still ignorance about the existence of and arrangements provided about the School expressed in certain quarters and it must be a matter of time to see if there would be any better response as the school would be better known in course of time by the propaganda methods already in vogue and by more and more students passing out and working in agriculture in villages.

Personal.

42. All the superior staff have worked faithfully and hard to the best of their respective abilities and capacities. Mr. P. V. Wagle, Entomological Assistant, even in his short period of work has shown himself out to be deserving inclusion in the list of special mentions.

V. G. GOKHALE,
Deputy Director of Agriculture,
Konkan Division.

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APPENDIX G.

Summary of work done under the Deputy Director of Agriculture, Sind, for the year 1922-23.

Organization.

1. There have been no new appointments during the year—but Khan Bahadur Azimkhan, Assistant Registrar of Co-operative Societies, has taken over Agricultural Propaganda in certain talukas, which will be referred to below.

The devolution scheme connected with Agricultural Engineering has also come into force in the course of the year. Under this scheme the Deputy Director has taken over the executive duties of the Agricultural Engineer, together with the subordinate establishment. The Agricultural Engineer, however, will advise in all technical matters.

Season.

2. The season of 1922-23 must be described as one of the best in recent years. The River rose timely, and a good level was maintained throughout the inundation season. There were no intermittent periods caused by temporary falls in the river level, and the inundation period extended well into October. At no time did the river rise very high, and hence areas which depend upon flood waters, did not receive quite so much submersion as is the case in many seasons, caused by a few days of very high river levels in August. The Jamrao and Mithrao canals worked very well in the *kharif* season, and the *rabi* supply was better than for many seasons, which was reflected by wheat sowings on a considerable scale.

The *kharif* rainfall, which is practically restricted to South Sind, was fairly normal, but the *rabi* rains which are such an important feature in the north of Sind, and which so greatly improve the bosi wheat, were much below normal, being hardly sufficient to be felt.

On the whole crops were good everywhere and there was ample fodder. The cotton crop is known to have reached 160,000 bales. Diseases and pests, however, were not absent. The Cotton crop in East Sind had a few bad weeks from boll-worm attack, and there was also a good deal of boll-rot. In certain parts of North Sind the rice crop suffered from " khas " sterility. Jowar on the other hand did not suffer much from either stem borer or " khas." There wasa fairly wide-spread attack of wheat rust but the climatic conditions caused it to sub-side before the damage became serious. The rat pest on wheat and rice was considerable in places.

There was no frost and the potato crop in Sukkur taluka was excellent in consequence.

The health of the people was not very good. Malaria and a mild type of influenza were abnormally bad in East Sind, and this greatly impeded harvest operations. As regards prices, the general fall which

affected cereals including rice and wheat, did not extend to cotton. Cotton in fact commanded excellent prices throughout the season, rising to Rs. 17 per maund of seed-cotton (84 lbs.) and never falling below Rs. 12.

Research and Investigation.

Cotton.

3. The botanical work on this crop is in the charge of Mr. Thadani of the Provincial Agricultural service. The problem in Sind is two-fold—

(1) The improvement of deshi cotton, which alone can be grown over the greater part of the cotton tract under existing irrigation conditions.

(2) The production by hybridization or otherwise, of an American variety, suitable to the Jamrao tract.

With regard to deshi, this cotton is not considered by the Trade to possess staple, but it is in high favour, because of certain other characters which it possesses in greater degree than do other cottons of a similar type in India. These are (1) roughness and (2) brightness.

The Agricultural Department isolated a large number of strains some years ago, and recent work has consisted in eliminating all but the best and in increasing the seed of the latter. The best strain is known as 27 WN. Other strains which were still under trial in the year under report are noted in the margin. The WN strains all did well in the year under report. Number 14 WN in particular has a very high ginning percentage. Selfed material of this group has been secured for further trial. The YN strains are midway between the WN and WB strains as regards earliness and yielding capacity, and hence it has been decided to reject this group, as also the WB group in which the strains are late and somewhat lower in yield than the WN strains.

30 W N 9 WB	22 Y N
3 W N 10 WB	20 Y N
5 W N	37 Y N
13 W N	1 Y N
14 W N	7 Y N
26 W N	18 Y N
	6 Y N
	45 Y N

The special advantages of these WN strains over ordinary deshi cotton are—

(1) high ginning percentage

(2) brighter colour

(3) rougher feel

(4) earlier and more even ripening.

In the year under report 27 WN again did very well. There was a block of 33 acres sown with this variety in May and June on the Seed Farm at Mirpurkhas and the average yield was 954 lbs. (*i.e.*, 12 maunds) of seed cotton per acre including plots attacked by wilt and damaged by "kalar" salts. The highest yield rose to 1,758 lbs. or 22 maunds pe

acre. In point of acreage yield, however, ordinary deshi is also capable of giving similar outturns under equal conditions, though the crop matures less evenly.

At Mirpurkhas this variety (27 WN) has been giving a ginning return of 16 seers of clean cotton per 41 seers of seed cotton, whereas Jamrao, deshi gives 13¾ seers of clean cotton.

This cotton was ginned departmentally to provide pure seed for distribution, and the ginned cotton was sold to Messrs. Ralli Brothers who purchased it for Rs. 44-8-0 per maund against Rs. 39-8-0, the rate for Sind-deshi. That Firm reported as follows "This cotton is an exceptionally desirable type of deshi cotton owing to its great roughness and its very high class and we are of opinion that even if it were cultivated extensively in Sind, it would always find ready buyers at a substantial premium over the ordinary deshi quality."

4. The work on American cotton includes the maintenance of pure seed of the Punjab F 4 variety, and hybridization between this cotton and certain high class American cottons. The special merits of Punjab F 4 are :—

(1) prolificness

(2) earliness

(3) relative resistence to red leaf blight—and general hardiness.

In point of yielding capacity it holds its own with Sind deshi and 27 WN, two very prolific cottons. On an area of 5½ acres at the Mirpurkhas Seed Farm the average yield was 1,008 lbs. of seed cotton, *i.e.*, 12½ maunds and there was a fair amount of kalar in the land. The best plot exceeded 20 maunds per acre.

As regards earliness it has been found that when this cotton is sown before mid-May, 90 per cent. of the crop is picked before the end of November. In the year under report practically the whole crop of F 4 was picked before the close of the month of November, the crop having been sown on the 21st to 24th April.

Selfed material has been obtained for providing the supply of pure seed of this cotton.

This cotton has a short fibre some ⅝ths to ⅞ths of an inch. Hence special efforts are being made to breed a variety possessing all the good characters of F 4, and in addition a staple of one inch or above. For this purpose a number of crosses were made in the year under report between F 4 and the marginally noted American cottons. The F 4 of the farm was ginned departmentally to provide pure seed, and the resulting ginned cotton was sold to Messrs. Ralli Brothers for Rs. 57-8-0 per maund—the rate for Sind deshi being Rs. 39-8-0 on the same day.

"Webber-49"
Durango.
Mebane.

5. Of the several varieties of American cotton which are being grown at Mirpurkhas, mainly to provide parents in hybridization but partly on their own account, the two most promising are Durango and "Webber-49",

These have yielded at the rate of upwards of 12 maunds of seed cotton per acre, and have shown a fair amount of hardiness in this, the first year of acclimatization. The staple runs from 1⅛ to 1¼ inches. These cottons were sown in the first week of May, and "Webber-49" appears to come very early to maturity.

6. Another promising cotton under trial at Mirpurkhas is Punjab 285. It was sown on a five acre scale in April in comparison with Punjab F 4. It has a staple of about one inch and appears to be a little later than F. 4. The average yield was 1,032 lbs. or nearly 13 maunds of seed cotton per acre against 1,008. lbs of F 4. The great bulk of the crop was harvested before the end of November, and the ginned produce was sold to Messrs. Ralli Brothers for Rs. 67-4-0 per maund against Rs. 57-8-0, the rate for Punjab F 4 on the same day. The best plot of this variety yielded 1,840 lbs. or 23 maunds of seed cotton per acre. This cotton does not appear to be quite so robust as F 4, but this year's results justify a more extended trial, and this has been arranged for with an enterprizing zemindar.

Mr. Thadani's report deals in detail with all his work on cotton, and contains the results of valuable observations upon the incidence of diseases and upon the botanical characters of the several varieties of cotton with which he is dealing.

Rice.

7. Botanical work under Mr. Thadani is being conducted on this crop at Larkana. There are a number of varieties in cultivation in the North of Sind, but the three marginally noted varieties have been selected for improvement. These represent the most important types, and the bulk of the rice crop is raised from these varieties. At present work is concentrated on isolating pure strains and testing these among themselves. To begin with, 100 strains of each were selected, but these have been reduced by selection to 10 principal strains in each variety. Selection is being made with special reference to the characters which determine yield, such as tillering capacity, length and branching of earhead, freedom from sterile spikelets and weight of grain. A certain amount of selfed seed will be secured in each strain to maintain its purity until the inter-strain comparative tests have been completed. After this the best strain will be maintained by the usual methods, and seed multiplied for distribution.

Jajai Sugdasi.
Prong Sugdasi.
Kangani.

8. The problem of sterility will be closely studied in connection with this rice breeding work. Mr. Thadani has observed that about 2 per cent. of the flowers of most of the varieties do not open at all, and of the open flowers a certain percentage give worthless grains. The total sterility due to these two causes acting together, occasionally rises as high as 32 per cent. of the total grain of the earhead—or even higher in individual plants.

Careful observations conducted in the year under report, show that rice fertilization takes place between the hours of 7-30 a.m. and 12-30 p.m.; and the most vigorous period is 10-30 a.m. to 11-30 a.m. The temperatures corresponding with these periods range from 86° to 99° F.

Wheat.

9. Work on this crop has been in progress for some years, and now there are a number of strains isolated from the best Sind varieties. These are being reduced by process of elimination. The two best known wheats in the North of Sind are Phundani and Thori and these are prolific varieties under good treatment—yields ranging up to 26 maunds or 2,080 lbs. having been obtained at Sukkur. Nevertheless the Department is recommending the public to go in for Pusa 12 which is also a very good yielder, and moreover it possesses certain other valuable characters in the high quality of the grain and in its immunity from rust.

In some villages it has been observed that Pusa 12 has been inclined to lodge. This is confined to the irrigated crop, and is probably brought about by the tendency to give the first irrigation too early. It is highly desirable to withhold the first irrigation from this wheat until it has had time to become well and deep rooted.

Among the red bearded wheats of Sind, cultivated in the south of the Province, it has been found that the F.S. type is the best, being both early and prolific. The former character is very important in the south of Hyderabad District where the climatic conditions are favourable to rust and the irrigation facilities are bad in the latter part of the season. In the Sindhi white bearded class a G.S. strain [36] promises to be very suitable for the Jamrao and Mithrao area, but here it will be in competition with Punjab 11 (an imported variety) which has been giving much satisfaction to Jamrao zemindars.

10. At the request of Mr. Howard a trial was given to seven other types of Pusa wheat which belong to his 50-series. These were grown in adjacent plots to Pusa 12 and Pusa 4. Several of these wheats are awned, whereas Pusa 12 and Pusa 4 are awnless, and it would be a great advantage if we could obtain an awned variety, possessing all the other good qualities of Pusa 12. The land at Jacobabad is not absolutely uniform, hence the results recorded below are not strictly comparable, but they give a good indication of the yielding capacity of these wheats. The yield figures are slightly increased owing to a soft threshing floor, and the weights recorded refer to unwinnowed wheat grain containing dust. These wheats were all sown in the third week of November and were grown by the " bosi " method, *i.e.*, the standing crop was not irrigated.

Among the observations made it was noted that the bearded types possess brittle and slippery straw, which caused some complaints from the men handling and carting the produce, as they could not load the carts to their full capacity, and there was much tendency for the stuff to work loose and drop on the road.

It will be observed that the bearded types have not yielded so well as the awnless types.

Name of variety.	Yield of grain in lbs. per acre.	Description of grain.	Remarks.
P 50* ..	1,488	Good and heavy ..	....
P 51* ..	1,480	Do. ..	....
P 52 ..	1,800	Lighter than above.	
P 54 ..	1,232	Do. and thin ..	
P 55 ..	740	Do. do. ..	Low yield due to effects of levelling land.
P 56 ..	1,200	Do. do. ..	
P 12* ..	1,950	Plump and heavy ..	Those marked with an asterisk are awnless, while the rest are bearded.
P 59 ..	1,394	Light-thin grain ..	
P 4 ..	1,920	Plump and good ..	

None of the 50-series possess grain equal in appearance and size to that of P 12 and P 4. The most attractive of the 50-series in the field was No. 56. This is a strong upstanding wheat deserving of further trial, but there is no evidence that any in this series are superior to P 12. On the other hand P 4 is doing fully as well as P 12 on this farm.

11. A trial was given to the well known Australian wheat "Federation" in the year under report. This variety has done very well in the North West Frontier Province. It is a short strawed or semi-dwarf variety. The grain is bold, and the crop stands up well. The yield on two acres was 13 maunds 26 seers per acre. It has been decided that this variety is worth a further trial.

12. All the Pusa wheats and Federation come to early maturity at Jacobabad, and it has been decided that none of them should be sown before the 20th November lest they flower before the 10th February when there is still the risk of frost.

In the year under report there was an outbreak of yellow rust which attacked all the wheats except Pusa 12 and Pusa 4, but the damage was not serious as the disease subsided before it had spread beyond the leaves. Further details of work on wheat will be found in Mr. Thadani's report.

13. The arrangements for producing a supply of high quality pure wheat seed at the Jacobabad Wheat Farm for primary distribution have worked well.

The seed grown on this farm amounted to over 1,100 maunds (in 1921-22) and this was distributed in the year under report. This seed was carefully graded in a rotary screen, manufactured by Messrs. Penny

and Porter of Lincoln, and only Grade I seed was distributed—amounting to nearly 1,000 maunds, of which 800 maunds, was Pusa 12.

In 1921-22 the area on this farm under Pusa 12 (Cawnpore Stock) was 44 acres, and the average yield was 1,464 lbs. (18·3 maunds) per acre.

The 1922-23 crop was also good but the yield figures are not yet available—and will be reported in next report.

Gram.

14. Several improved varieties of gram evolved by Mr. Howard of Pusa, are under trial at Jacobabad. Some of these are very excellent yielders ranging round 20 maunds (1,600 lbs.) per acre. The white varieties (numbers 6 and 9) are rather late in coming to maturity, and are thus exposed to the damage caused by the hot westerly winds which set in towards the end of March.

Number 10, a red variety, appears to be about the best of the lot, as it is a good yielder and was valued at Rs. 4-2-0 per maund in the local bazar, while some of the other types (numbers 17 and 25) were valued at Rs. 3-7-8 owing to the dark colour of the grain.

Berseem Seed Production.

15. The cost of imported seed has been Rs. 40 per maund in recent years and as the seed-rate is 40 lbs. per acre, the cost of seeding an acre has been Rs. 20.

It is important in view of the future possibilities of berseem in Sind, to clear up the question whether good seed can be produced in Sind. Experiments at Mirpurkhas have not been very promising, but the climatic conditions in May when the crop is maturing, are very severe owing to the prevalence of strong hot winds.

In the North of Sind these winds do not prevail, and berseem seed has been successfully produced both at Sukkur and Larkana. An average yield of 240 to 200 lbs. or 3 to 3½ maunds of good seed per acre has been obtained at both places, and over 4 maunds have been obtained on certain plots.

It has further been observed that :—

(1) A couple of cuttings of green fodder may be taken, before assigning the crop to seed, without prejudicing the outturn.

(2) A crop intended for seed should be sown timely, *i.e.*, not later than Mid-October.

(3) The crop should be amply irrigated till about Mid-April.

(4) The outturn of seed can be increased by manuring the land with cattle dung, and this is recommended.

Fruit.

16. The question of exploring the possibilities of fruit in Sind is receiving the careful attention of Government. A scheme for placing the work on a sound basis has recently been drawn up by a Committee of the three officers noted in the margin. This Committee has pointed out the special advantages for fruit inherent to Sind, including freedom from disease. Thus the grape does not suffer from either mildew or anthracnose which devastate the Nasik gardens. There are none of the Loranthus parasites which are the curse of mango plantations in the Deccan, and of all fruit trees in the Nelgiris. The Citrus group are practically free from die-back which makes the cultivation of the Santra Orange (even at Nagpur) so unsatisfactory. These varieties of fruit grow well, look healthy and yield well in Sind.

The Deputy Director of Agriculture, Sind.
The Economic Botanist to the Government of Bombay.
The Horticulturist to the Government of Bombay.

In addition, the North of Sind is peculiarly favourable to the date which has been grown in this tract since the time of Alexander. The fig is another fruit which does very well in Sind.

At the present time the limited supply of irrigation makes it difficult to extend the fruit area in Sind, but there are several centres up and down the Province which have acquired a considerable reputation for fruit: thus we have Shikarpur in the North, Tharushah in Central Sind and Hyderabad in the South. With the construction of the new canals associated with the Sukkur Barrage scheme, some eight million acres will come under the command of perennial flow irrigation.

It is clear that the facilities for growing fruit in Sind will then become exceptional.

17. The fruit industry naturally falls into two sub-divisions:

(1) fresh fruit

(2) dry fruit and products made from fruit.

In a country like India the best opening for the fresh fruit industry lies with those fruits which can be readily transported, such as oranges and grapes. The dry fruit industry on the other hand has a wide field, as it is free from the limitations inherent in the fresh fruit trade, in which the perishable nature of the produce demands early sale and prompt transport. The Committee consider that the most promising new lines of development for the dry fruit industry are the production of raisin grapes and lime juice (from sour limes). The Committee also recommend that the existing date industry be aided by organising the supply of good stock from Mesopotamia and elsewhere. These suggestions imply that it will be necessary to employ a scientific officer of Provincial rank to control and direct these horticultural investigations, and it is proposed that part of the Mirpurkhas Experimental Farm should be placed at his disposal, where he would work out the economic aspect of the problem. It is essential in the first place to investigate the yield per acre on a fairly large scale, of raisin grapes and limes, and also to ascertain the quality of the raisins and juice of the sour

limes, and generally to study all the essential points underlying the culture of these fruits and the preparation of their products. At the same time the market for these commodities would be carefully tested. In this way it would be possible to arrive at a definite conclusion with regard to the prospects of a fruit industry in Sind, and how it should be organized. This would be a most valuable piece of knowledge to place before the public when the country possesses reliable perennial irrigation.

18. In the meantime the work on fruit at Mirpurkhas continues on a small scale. In the year under report 1,600 young fruit trees were sold. These were chiefly oranges, mangoes and vines.

Soil Fertility.

19. This problem has received considerable attention at Mirpurkhas. Under the existing conditions in Sind, land is so much in excess of water that there is little pressure on the soil fertility. In the inundation canal areas land lies fallow for 2, 3 or more years. Even on the Jamrao area the canal is designed only to irrigate one-third of the commanded area in a year, but owing to much "kalar" (salts) rendering considerable areas difficult to cultivate, cultivation tends to be restricted to the sweet land, and much of this is cropped once in two years. Even so it is generally observed that the fertility is falling, and enterprizing zemindars dress their land with silt or manure, so far as it is available.

In order to study this question several experiments have been conducted on the Mirpurkhas Experimental Farm. On one plot (B 7) wheat was grown continuously from 1908-09 to 1921-22, with three exceptions, and during the last five years of this period a green manure crop of sunn grown in the kharif season was ploughed in and the plot sub-divided into eight sub-divisions, of which four were given phosphatic manures in addition to the sunn. Nevertheless the fertility judged by crop yield fell to a minimum level, ranging from 2 to 4 maunds, during the last 10 years, against 13 maunds in 1909-10. Samples of the soil were taken in 1922 from the control sub-divisions which had received no artificial manures. The analyses of these are tabulated in the following statement :—

Constituents.	Soil samples taken from Plot B 7 of Mirpurkhas Experimental Farm.			
	I Surface layer of 6 inches.	II Subsoil layer of 6—14 inches.	III Subsoil layer of 14–22 inches.	IV Subsoil layer of 22 to 30 inches.
Loss on ignition	7·34	5·60	5·36	5·52
Lime	4·53	6·27	4·64	2·64
Nitrogen	0·16	0·15	0·09	0·08
Phosphoric acid	0·16	0·17	0·16	0·13

Owing to retrenchment the Agricultural Chemist to the Government of Bombay did not determine the potash—but this constituent is probably not a limiting factor to the fertility of this soil. The Agricultural Chemist's comments on these analyses, are "I think the soils sent by you are all rich in lime and very good in phosphoric acid. Numbers 1 and 2 are very good in nitrogen also, while numbers 3 and 4 are fairly good in that constituent." These analyses show that the cause of exhaustion is not lack of plant food, and this is confirmed by the absence of response to phosphoric fertilizers which have been applied every year to four of the eight sub-divisions of this plot.

20. These results confirm a general observation in the Jamrao tract. It has been noted that when wheat is grown for the first time an excellent crop may be expected, but if a second crop is taken 2 or 3 years later without manure then the yield is materially lower. The yields of other cereals also tend to fall away rather rapidly, while cotton on the other hand continues to give good returns. As the cause of this phenomenon is apparently not lack of plant food, the explanation appears to lie in the effects of irrigation upon the texture of the soil, damaging this and presumably reacting unfavourably on the bacterial life in these soils.

All experience goes to show that where the texture is improved or maintained—then a high level of crop yield may be counted upon.

This can be achieved in three ways.

(1) by long fallows of several years.

(2) by increasing the organic matter in the soil.

(3) by applying canal silt.

The texture of the soil does greatly improve on land left fallow for a long period, even if it is not cultivated, but this is not a practical system where good irrigation facilities exist.

It is essential in such circumstances to adopt the second or third method. The third method is practised in many parts of Sind, especially in the north, where excellent silt can be obtained from the spoil banks of the inundation canals. The second method is to be recommended wherever good silt is not forthcoming. The supply of organic matter in the form of cattle manure, is however very limited, and the Department has been investigating alternative sources. For the purpose, however, of fixing and keeping in view, a standard of crop outturn to aim at, a three year rotation of cotton, wheat and bajri is being maintained at the Mirpurkhas Experimental Farm, in which an application of 5 tons per acre of cattle manure is applied once in three years. This provides for an intensity of 100, or one crop per annum on the land. Altogether six acres are devoted to this rotation, that is two acres to each crop. In the year under report, as may be noted in the margin, excellent yields of cotton and wheat were secured while the bajri crop was only moderate. The most successful alternative to cattle manure is the cultivation of berseem or

Name of crop.	Average yield in lbs. per acre.
Cotton ..	1,242
Bajri ..	664
Wheat ..	1,718

Egyptian Clover in the rabi season, as this crop has a penetrating fibrous root-system which greatly improves soil texture. This crop however can only be grown on a very small scale at present owing to the limited supply of irrigation. A piece of land on the Seed Farm at Mirpurkhas has been assigned to this method of providing organic matter to the soil.

Green-manuring with sunn is being investigated, but this involves the loss of a productive crop once in three years.

It has also been observed that Sawas (Panicum Miliare) adds a large amount of organic matter to the soil owing to its tillering and fibrous root-system, and this is being grown with good results on land infected with " kalar " salts.

Implements and Machinery.

21. This is a very important problem in Sind. At present there is no whole time Agricultural Engineer—but such an appointment would be fully justified in view of the scope for good work in this branch of Agricultural development.

The plough is of course the most important implement in Sind, and local experience shows that improvement must begin at the bottom. The wholesale introduction of costly iron ploughs can not be the first step as the purchase of such implements—costing some Rs. 40 to Rs. 50—does not harmonize with the capital available for investment in dead stock by the cultivator, who is either a khatedar or tenant. Such a man responds much more readily to a cheap implement which is within the capacity of his purse, and the draft of which is not materially greater than what his bullocks are accustomed to. Another very important consideration is that a cultivator does not wish to invest much money in an implement which he can only rarely use.

Irrigation is only available for land under crop or about to be sown—hence the time available for tillage operations, is short. Irrigation is not available for facilitating tillage operations on fallow land, and without it such land is generally too dry for iron ploughs, as only a narrow sharp pointed tine can penetrate the soil in a dry state, with bullock power. In parts of the rice tract the conditions are more favourable as there is sufficient moisture left in the soil for a few months after harvest to permit of an iron plough working satisfactorily.

These considerations do not rule out the more expensive implements, but they explain why the public do not care to purchase them out-right. The most promising line to follow in this connection is to establish lending depots, where the people can obtain the use of such implements for a few days at a time, when and as required, and for a small hire charge. The Department has been investigating this alternative in the Sukkur Taluka with promising results, *vide* paragraph 61 below, and steps are being taken to develop this system.

22. During the course of the year an improvement in the design of the Egyptian plough has been worked out. In the existing design an iron

bar to adjust pitch, passes through a slot in the beam. It has been found that this is a source of weakness, and by the new arrangement the beam is supported within a fork-shaped iron piece which permits of the same adjustment.

In some parts of the Province the people are showing a disposition to go in for a very light type of iron plough of the " Meston " class. At Jamesabad a local mistri has been manufacturing for some years an imitation of this plough (price Rs. 10), and his sales are becoming considerable, *vide* paragraph 49 below.

Messrs. Burn & Co., however, are prepared to supply ploughs of Meston type at Rs. 8 each (Calcutta delivery) if ordered in large consignments of 50 at a time, and the Agricultural Inspector, Middle Sind, thinks these will find a sale in Shadadpur taluka. Mention was made of the " Orient plough " in last year's report, as being very promising for Sind. In the year under report the plough has received the careful attention of Mr. Schutte, who has made a few alterations in the design. That Officer is now working upon these modifications, and he is also going carefully into the cost of producing such a plough in this country. He is very hopeful that such a plough could be produced and sold for Rs. 15. If this proves to be the case then there is certain to be an excellent field in Sind for these ploughs—as they are a distinct advance on the Egyptian and Meston ploughs. They have beams and handles similar to Indian ploughs and hence the people handle them more naturally than the Western plough. On the other hand they have a good range of depth in ploughing, and turn the soil over well. This plough will be preferred by many to the Rajah plough or its imitations. The latter however is a very good plough and is particularly useful in stiff land or land infested with grass, where it preserves its balance better than does any one-handled plough. For such work, and particularly for hire purposes, the Rajah plough should continue to fill an important place in the tillage needs of the Province. With regard to the imitation Rajah, called Sirdar plough made by Messrs. Kirloskar Brothers, the price Rs. 40 is not sufficiently low to facilitate a ready sale—and moreover the draft is greater which is a distinct disadvantage, as the Rajah plough itself is criticised on this ground.

23. After the plough the most useful tillage implement on stiff land is the Cambridge roller. Owing to the wide distribution of " kalar " salts in Sind, much of the land has a bad physical texture, and hard clods are produced in ploughing such soils. The ordinary samar or flat wooden beam makes very little impression on such clods. It is a common sight in many parts of Sind to see men breaking clods with wooden mallets. Messrs. Howard & Co. of Bedford have made a special roller, at the request of the Department. This is only 4 feet wide, and it is fitted with notched rings 16 inches in diameter. It can be drawn by one pair of strong cattle. This roller has been found most efficient on the stiff land at Mirpurkhas. One of these rollers has been demonstrated in the district and it has been greatly appreciated. Such an implement is very suitable for stocking in a hiring-out depot as its cost Rs. 300 is more

than an individual cultivator can be expected to incur. Mr. Schutte is investigating the possibilities of producing a cheap imitation of this roller in India.

24. For some years, the Department has been in search of a good drill which will do good work under Sind conditions. Cotton is normally sown broadcast, but line-sowing has been adopted on Government Farms, and this method has been demonstrated in the district for several seasons. Hitherto no really satisfactory drill has been forthcoming. The drills used in the Presidency on black soil, are of little use in Sind as the requisite tilth for these is more difficult to prepare. The drill which has been provisionally adopted, is simply an adaptation of the Marwari plough with a tube fixed behind. This is a one—coultered drill and it does work of fair quality, but it still leaves much to be desired, as regards regular sowing and reliability. In the year under report the Department imported an American cotton drill manufactured by Messrs. John Deere & Co. of Illinois. This is know as 236 Cotton drill. It cost Rs. 219-11-0 landed in Sind. This drill sows two rows at a time and the seed rate can be regulated through a wide range. This drill is fitted with disc openers which readily penetrate the soil, and these are much more suitable for this class of soil than the runner openers which offer too much resistance and in consequence get thrown out of the soil. Sowing is of course automatic, and therefore the seed is dropped regularly. On the whole this is a promising type of drill, but it is perhaps a little too complicated in gearing for the Sind cultivator, and the depth to which the seed is dropped, is not too easily regulated. The ideal cotton drill for Sind has yet to be designed, but this drill should form the basis of any new design which should be simplified, and a more convenient arrangement for regulating depth should be devised. The principle of disc openers should be retained.

For wheat sowing the Hoosier disc drill has given much satisfaction at Jacobabad. This machine is fitted with 12 discs, set 6 inches apart; but as the sowing has to be deep, alternate discs are removed and the remaining 6 discs sow six lines, one foot apart, which is the interspace in the case of the local method of drilling. This drill is worked by one strong pair of bullocks, but as the draft is heavy, it is found advisable to work a different pair in the afternoon. This drill sows an acre in an hour and a half, and the cost of sowing works out at 6½ annas per acre against 18 annas by the local method. Moreover the sowing is most regular and the quality of work much superior to that of the local method. This machine costs Rs. 470 in Bombay and is suitable for a big zamindar or for a lending depôt. A smaller Hoosier drill has recently been obtained for trial. This machine costs Rs. 170. It sows five lines at a time—the space between the lines being adjustable. It has not yet been tested, but it appears to be built on rather too fragile lines.

25. The separation of grain from bhusa, after cereal crops in India have been threshed, is an old problem. Winnowing machines do this class of work in a very unsatisfactory manner, and in fact are not designed for this object. Messrs. Penny and Porter of Lincoln have co-operated

with this Department in producing a machine for separating jowar grain from bhusa. This machine consists of a rotary perforated screen with a strong blast from a fan. This blast is sufficient to blow the lighter bhusa over a vertical iron sheet while the heavier grain falls to the ground. This machine has not yet been perfected and is now receiving the attention of Mr. Schutte who is making certain modifications. This machine is operated by one man who turns the handle at the rate of 40 to 50 revolutions per minute. It appears that an output of some 600 lbs. of grain per hour will be possible. If Mr. Schutte succeeds, as he hopes to do, in showing that the modified machine can be made in India within Rs. 150 there is certain to be a very great demand for such machines.

26. The problem of improving upon the Crude Persian wheel for lifting water by bullock power, is still unsolved. In the year under report the Department has been testing an Aquatole (one foot width of chain), and the ultimate solution seems to lie in a cheapened design of Aquatole. As made in England, there is too much metal in it and the cost, Rs. 1,670, places it beyond the ordinary man's reach. It seems quite probable however that, while retaining the main features of the design, the materials of construction might be much less expensive. It is highly desirable that the possibilities of a cheap type of Aquatole should be fully explored.

27. At Jacobabad the Cletrac tractor has been giving satisfaction under the careful control of Mr. Barkazai, Farm Superintendent. The best ploughing work has been done with a furrow-plough. The available plough (P & O self lift) has only two bottoms, but in this soil it is clear that the tractor is underloaded and that it could very easily haul a three-furrow plough. This outfit was kept running continuously every day for three weeks and the following observations were made :—

(1) A two-furrow plough requires one and a half hours to plough one acre.

(2) The area ploughed in a day was 4 acres, but if time had not been lost in measuring fuel and water and making other observations—it would have been practicable to complete 5 acres.

(3) The ploughing was "bosi" wheat stubble and the depth 6 inches—which was as deep was desired.

(4) The consumption of snowflake kerosine oil was 15½ lbs. per acre.

(5) Four gallons of water were put in the radiator and two gallons added in the course of the day.

(6) The water air-clarifier requires about one gallon of water per two acres of land.

(7) There were no stoppages caused by break-down.

(8) The running expenditure per acre amounted to—

Item.	Amount.	
	Rs. a. p.	Rs. a. p
15½ lbs. snowflake oil	2 9 0	
5 ozs. of petrol	0 2 0	
1 lb. of lubricating oil	0 5 0	
⅛lb. grease	0 1 0	
½ lb. cotton waste	0 1 3	
Labour charges	0 4 0	3 6 3

If the tractor and plough be valued at Rs. 7,000, and if over head charges be calculated at the rates shown in the margin, then in a year containing 200 working days, the cost per acre would amount to Rs. 2-11-9 which when added to the running expenditure, amounts to Rs. 6-2-0. With a three-furrow plough which would cost very little more to run—the cost per acre would be reduced and should not exceed Rs. 5.

Interest at 6½ per cent. per annum.
Depreciation at 20 per cent. per annum.
Repairs at 5 per cent. per annum.

It is reported elsewhere, *vide* paragraph 61 below, that the public have been paying Rs. 6 per acre to the Department for ploughing their land with the Rajah plough. Hence there appears to be a definite opening for tractor-ploughing in the North of Sind.

At Mirpurkhas tractor investigations have brought out the special value of the Norwegian harrow and the Orwell cultivator for preparing a seed bed for cotton, but it is advisable to have the land well ploughed up some months previously, if no ploughing at the time of sowing is to be done.

Tillage and Cultural Operations.

28. In Sind the usual method of sowing dry crops is to broadcast the seed after the irrigation water has dried up and cattle are able to walk over the land. in some cases a preliminary ploughing may be given. The seed is then buried by ploughing the land. This method, though very haphazard, has one important advantage. It provides for putting the seed into the soil with the minimum interval of time after irrigation. This ensures sufficient moisture for germinating the seed. In the kharif season the top moisture disappears with great rapidity under the influence of a strong sun and drying winds which characterise the Province. Hence it has sometimes been found, if much time is spent in preparing a fine seed bed, the soil moisture may recede too deep for a good germination, even when the seed is drilled well down. Hence the most successful method of drilling cotton at Mirpurkhas has been

to have the land ploughed up some months in advance. Then the field is watered when the sowing season arrives, preferably twice. The seed bed is then rapidly prepared by ploughing and clod crushing and sometimes discing, and then the seed is drilled without delay, preferably on the same day on which the first tillage operation after watering, is done. In this way the advantage, mentioned above as associated with the broadcast method, is secured.

29. The work at Larkana on ploughing rice stubble with an iron plough in the winter is being continued with good results. With regard to the investigations at Larkana on rice seed economy, good results with the reduced seed rate of 20 lbs. per acre continue to be got, but it has been observed that the seed rate must depend to some extent on the date of transplantation. It is observed that late sown rice must be transplanted more thickly than early transplanted rice, owing to the shorter period available for tillering and after growth.

30. The "bosi" wheat crop at Jacobabad was rolled with the Cambridge roller when a few inches high with excellent results. This had the necessary packing effect upon the soil and brought up the moisture, which was evident from the good colour which the crop assumed. Much interest was shown by the public in this operation.

Irrigation.

31 The investigations upon the "duty" of rice were continued at Larkana, and the results confirm those of last year that a duty of 40 can be expected, while there are indications that a duty of 45 may be obtainable.

32. At the request of the Irrigation Department a series of careful observations were made in the Nara valley, to elucidate the irrigation requirements of the local Ratria variety of rice. In the autumn months water is in great demand on the Jamrao and Mithrao canals for finishing the cotton crop and for sowing wheat, but the people demand water for Ratria rice, until the end of October or beginning of November. These observations were conducted at three centres so as to be representative of the Upper, Middle and Lower sections of the Mithrao canal.

The results have been carefully recorded and some of the chief points noted were—

(1) Sowings were done between the 20th of May and end of June.

(2) Flowering did not commence until the 6th to 12th October and was not complete until the 16th to 23rd of October.

(3) The crop ripened from the 1st to 10th November.

In these circumstances it would seem necessary to provide irrigation for this crop at least, till Mid-October.

Livestock.

33. The Department has a small herd of Delhi buffaloes at Sukkur where the object is to breed bulls of a good milk strain. In several

parts of Sind, notably in Kamber Taluka of Larkana and in Shahbundar sub-division of Karachi district there are large numbers of milch buffaloes, many of them good milkers.

The Sind buffalo is not very definite in breed, but it belongs broadly to the Delhi type, and good bulls of the latter breed appear to be very suitable for grading up the Sind stock.

At Sukkur it is only possible to carry on this work on a small scale as the stock are stall-fed, and there is no grazing area apart from open jungle. The plan adopted hitherto is to keep the young stock of selected animals only and to send them to Larkana for rearing, after being weaned. There are at present 10 young bulls of various ages. The performances of a few of the animals are summarized below :—

Name of she-buffalo.	Serial No. of calf.	Dates of calving.	Yields of milk.		
			First 300 days.	Full lactation period.	Highest yield per month.
Makhni	1	25th August 1918 ..	5,356	5,753	687
	2	6th December 1919.	6,712	7,454	940
	3	28th April 1921 ..	4,728	4,730	728
	4	1st April 1922 ..	5,499	5,559	875
	5	8th March 1923 ..	..	..	..
Mumal	1	10th July 1918 ..	4,433	4,504	566
	2	23rd August 1919 ..	5,630	6,219	656
	3	11th January 1921 ..	5,160	6,602	739
	4	27th May 1922 ..	6,297	6,958	776
Suhni	1	4th August 1918 ..	4,084	4,544	548
	2	2nd October 1919 ..	5,011	5,011	647
	3	2nd November 1920.	5,663	5,966	850
	4	9th March 1922 ..	5,826	6,126	865
	5	15th April 1923 ..	..	..	..
Misri	1	25th September 1918.	4,045	4,075	562
	2	9th October 1919 ..	4,413	5,652	518
	3	23rd April 1921 ..	3,357	3,357	668
	4	5th April 1922 ..	5,014	5,127	811

Seed supply and extension of area under new or improved varieties of staple crops.

34. In most parts of India little real difficulty seems to have been met with in extending the area under new or improved crops, once their merits have been recognised. Private seed farms and co-operative

seed Unions have been organised with comparative ease. Growers have co-operated with the Agricultural Department in the disposal of their cotton, so that the improved produce found its way in bulk to one or two, or at most a few large buyers, who in turn have stored and ginned it separately. Thus seed of improved crops has been rapidly multiplied in a state of fair purity, and the growers have been in a position greatly to extend the areas from season to season. A ratio of extension of 10 : 1 has been found practicable in some parts of India.

In Sind on the contrary much difficulty has been experienced in extending areas under improved varieties because of the seed not being forthcoming. There is in fact a remarkable leakage in seed due to several causes, some of which are described below. To take the case of cotton first, the following causes may be mentioned :—

(1) Under the landlord and tenant system there are two parties to the cultivation of the crop. The landlord may be keen but his tenants careless ; so that any gaps caused by faulty germination may be filled by deshi seed.

(2) Advance sales in order to raise ready cash are common. Such produce is apt to get separated from that which is sold after maturity.

(3) The produce is sold in driblets in the village, either to petty dealers or commission agents of larger firms. These middle men buy a little here and a little there. In one village it may be the improved variety, in another the deshi, or some of both in both villages. The average purchaser finds it inconvenient to pack up and keep separate different lots of cotton. It suits him better to lump it all together when filling his gunnies. Moreover the petty men resell to other dealers, and thus the produce passes through a multitude of hands before being ginned. Unless each individual in this chain of dealers takes special precautions there is no chance for the improved variety remaining intact.

(4) In certain ginneries owing to careless management the seed of improved varieties becomes mixed up, notwithstanding the efforts of the Departmental staff.

For these reasons the improved variety is either lost altogether or becomes so adulterated that the seed is not worth recovering. An example may be quoted. In the year under report some 265 maunds of seed of an improved variety of cotton was issued in East Sind, but only some 81 maunds were ultimately recovered from the produce, after much effort.

35. The remedy seems to lie in flooding certain selected villages with seed of the improved variety, so as to exclude all other seed, and to arrange with one or two large firms to make it their special business

to buy up the whole, or as much as possible of the produce in these villages, and to gin it separately. Before it is possible to flood a village with seed, that seed must be produced in considerable quantity under Departmental control.

For this purpose the Department has taken up an area of waste land commanded by the West branch of the Jamrao canal, in deh Chellaro, near to Dhoro. This land will be cultivated by the tenants of the Department under very close supervision. In this way the seed which is multiplied in the first instance on the Government Seed Farm at Mirpurkhas will be given a second multiplication at Dhoro. The seed from the Dhoro produce will be issued to one or more selected villages, so as to sow the area completely and allow a good margin for any resowings.

In the current season this scheme is being worked only in connection with an improved strain of deshi cotton, 27 W.N. If it works satisfactorily it can be extended to American.

36. Meanwhile the supply of pure American seed is presenting much difficulty. Messrs. Ralli Brothers who purchased most of the 1922-23 crop, reported that on the average it contained 13 per cent. of deshi and the best contained about 8 per cent. The demand for this seed does not declare itself till March when the state of the river determines the public whether to sow or not to sow American cotton. In the present season irrigation prospects were good in March and the Department endeavoured to import seed in bulk from the Punjab, but most of the Punjab seed is disposed of before this time, and it was only possible to import a small quantity of seed. In view of this experience it seems essential that the Agricultural Department should undertake the risk of importing 5,000 maunds of pure American cotton seed from the Punjab in December next so as to be able to meet the demand for seed in March 1924, if it arises. If it does not arise, then the seed can be exported. The risk involved would amount to about Rs. 5,000.

37. With regard to wheat seed, this has also proved difficult to recover. Even from a large seed grower it is rare that more than two to three times the seed issued to him is recoverable in practice, as his tenants receive half the crop and he keeps something for his own requirements. In north Sind some 1,700 maunds of Pusa 12 seed were issued in the year under report, but it is not now expected that more than some 3,000 maunds will be recoverable. This is partly because some of the seed has been issued in small lotes for propaganda purposes. In this case also it seems essential rapidly to fill up a few villages, with this variety. When this is done it will be more practicable to organise the re-purchase of the whole surplus produce in these villages because the crop will be pure and there will be no need for special arrangements to obtain the produce of this man and reject the produce of his neighbour. In order to achieve this object of rapidly filling up a group of villages with pure Pusa 12 seed, it will be necessary to import a large consignment

of say 4,000 or 5,000 maunds from the United Provinces. Recent enquiries show that this will involve a loss which can be calculated. It is strongly recommended that expenditure to the extent of Rs. 5,000 be incurred for this purpose.

38. Finance is another aspect of the seed problem in Sind of great importance. In other Provinces where operations have become considerable, the financial organization has been mostly provided by Co-operative Seed Unions and Societies. Hitherto it has not been possible for the Co-operative Department to develop these Unions, and in their absence the only alternative is private enterprize, as the limit to which Government can go is soon reached. K. B. Azimkhan, Assistant Registrar, has been successful in inducing a large merchant of Tando Adam to finance cotton seed operations and a similar arrangement has been made with other merchants in the north of Sind to finance wheat operations—but this arrangement can hardly be regarded as final as those merchants are not philanthropists, and they cannot be expected to hold on to their wheat stocks with a falling market, Seed Unions seem essential for this reason and also to prevent any undue profits being made.

Propaganda.

(Organization.)

39. The Province was found too large for one Divisional Superintendent as this involved excessive railway travelling. Accordingly it has been divided into the marginally noted three divisions, and two agricultural Inspectors have been appointed, one in charge of middle Sind and one in charge of North Sind. These changes were effected in 1921-22, but the year under report is the first full year in which the scheme has been operative. This plan has worked well as the conditions and problems of these three divisions are fairly distinct. East Sind covers the area which in theory at least, receives perennial irrigation from the Jamrao and Mitharo canals. The cultivation of American cotton is limited to this area and the irrigation of field crops in the rabi season is confined to this tract, except the relatively small areas irrigated from wells.

East Sind,
Middle Sind,
North Sind.

Middle Sind covering Nawabshah and the non-rice talukas of Hyderabad, includes the best deshi cotton cultivation and is characterised by "lift irrigation". In this tract there is very little rabi cultivation except along the river margin, where moisture has been stored from flood waters.

North Sind includes the finest rice tract in the Province. It also includes most of the "bosi" area, that is the land irrigated in the kharif season but not cropped till the rabi season, with wheat or oil seeds or gram.

Division.	Talukas.
East Sind ..	Mirpurkhas. Jamesabad. Digri.
Middle Sind ..	Hyderabad. Hala. Shahdadpur. Tando Allahyar.
North Sind ..	Sukkur. Ghotki. Kamber. Larkana.

40. Within these divisions the Department is concentrating its work within the marginally noted talukas in order that it may be more intensive and sustained, as the staff available for propaganda is still very small.

The staff allotted to each of these divisions consists of one Divisional Superintendent or Agricultural Inspector and three Agricultural Overseers—the plan being that each taluka should, if possible, have one Agricultural Overseer.

41. Late in the year under report a further development in this organization took place. This consisted in combining Co-operative and Agricultural propaganda under the control of one officer. Khan Bahadur Azimkhan took charge of this combined work in Middle and North Sind towards the end of February 1923.

42. During the year under report Government constituted Divisional Boards of Agriculture for each important division in the Presidency including Sind. The Sind Divisional Board of Agriculture held its first meeting in August 1922, and it meets three times a year. The Board consists of two officials and four non-officials. The two officials are the Deputy Director of Agriculture and the Assistant Registrar of Co-operative Societies. The names of the four non-officials are noted in the margin. Two of these gentlemen represent Agricultural interests and two Co-operative interests. The Chairman is the senior official for the time being. The Board is intended to be a small compact businesslike body, and its primary function is to keep the work of the Department in accord with the wishes of the public. It concerns itself, in particular, with propaganda work both co-operative and agricultural. For instance, it scrutinizes the quarterly progress reports and programmes of the propaganda officers and approves of all expenditure incurred on such work. It gives special attention to promoting non-credit co-operation, and makes recommendations upon applications for loans for agricultural improvements under the Land Improvement Loans Act (XIX of 1883) and the Co-operative Societies Act. More recently there has been a movement to organise Taluka Development Associations. The object of such bodies is to organise the people of a taluka for the purpose of undertaking improvements which will benefit the taluka as a whole. Such bodies are expected to raise funds by subscriptions, donations and fees. Applications from such Taluka Development Associations for registration are submitted in the first place to the Divisional Board for approval. Government will also give grants-in-aid

Khan Bahadur Bhutto.
KhanSahibChakurkhan.
Mr. Jamshed N. Mehta.
Mr. Manohardas Kauromal.

to such Associations subject to certain conditions and to the approval of the Divisional Board.

Hitherto applications for registration have been received from eight Taluka Development Associations, and it is understood that these are being registered.

The work of the year.

43. Agricultural propaganda has been pushed on in each of the three divisions mentioned in paragraph 40 above, along the main lines described in paragraphs 25 to 28 of last year's report, and it will be convenient to refer to each division separately.

East Sind.

44. *American Cotton.*—Considerable progress was made in the year under report owing to the supply of irrigation being favourable, especially in the early part of the season (March-April) when sowings take place. The public are firmly convinced that American cotton to be successful, must be sown early; hence the area sown depends upon the irrigation conditions in March and April. Given good conditions in these months, it is quite safe to assume that the people of their own volition will sow a relatively large area under this cotton on the Southern Jamrao. In the year under report the exact area could not be ascertained but it was probably between 5,000 and 7,000 acres as the crop amounted to some 2,000 bales—against 3,000 acres estimated in the preceding year. This is the largest area sown under exotic cotton in one season since the Department began its efforts to introduce stapled cotton into Sind.

This fact is significant because the Department issued only a small proportion of the seed required to sow this area, and hence it may fairly be inferred that the people themselves took the initiative to obtain seed from any available source. Enquiries show that the chief sources of supply were—

Source of seed.	Amount of seed issued in maunds.
Agricultural Department	337
Jamesabad Factory of the Hon. Mr. Bhurguri ..	1,167
Mirpurkhas Factory of Messrs. Ralli Brothers ..	36

The variety sown was Punjab F4 and this is undoubtedly the most suitable American cotton for Sind under existing conditions as it rapidly matures—taking rather less time than deshi—and releasing autumn irrigation for a *rabi* crop like wheat. This is obviously a very important economic character. It, moreover, is less susceptible to damage from

red leaf blight than other American cottons. This cotton, however, would never have been taken up by the people unless it had proved a good yielder. It is undoubtedly prolific and compares very favourably with local deshi which is also very prolific. If sown in good time it yields fully as much seed cotton as deshi, while under specially favourable conditions the outturn is very high, *e.g.*, in Kathri locality Ghulam Nabi Bozdar picked 65 maunds (80lbs. per maund) of seed cotton from an area of 3¼ acres.

This cotton commanded a premium of 2 annas on the rupee for seed cotton over deshi. In this connection it may be pointed out that trade competition is hardly sufficient to ensure this premium as purchases are made very largely by one Firm, Messrs. Ralli Brothers. Fortunately this Firm takes a very long view, and has decided to buy all American cotton offered to it at this premium in order to encourage its cultivation, in the belief that such encouragement will ultimately react to the benefit of the Firm. Messrs. Volkart Brothers have recently opened a factory at Mirpurkhas and are also showing much interest in this cotton.

45. It may safely be said that the area under this cotton would have risen to some 15,000 acres in the current season (1923-24) if good pure seed could have been secured. Unfortunately the local supply of seed is most unsatisfactory. As pointed out in paragraph 36 above, Messrs. Ralli Brothers reported that the American cotton purchased by them contained on the average 13 per cent. of admixture, and that the best samples contained 8 per cent. admixture. At the suggestion of the Agricultural Department Messrs. Ralli Brothers exported most of this seed.

It is probable that pure American seed in bulk will continue to be difficult to secure in Sind under present conditions, because it is not practicable to oust deshi completely so long as the irrigation supply in March-April is doubtful. Both cottons will continue to be grown side by side. Of course certain growers will take special precautions to keep their American crop pure, and the Department succeeded in obtaining upwards of 600 maunds of seed from the produce of such men. The procedure adopted was inspection by the staff of the Agricultural Department, who registered those zemindars whose crops were pure and who had had their crops "rogued". A list containing these names was supplied to Messrs. Ralli Brothers who kindly stored the seed cotton separately and arranged for its separate ginning. This seed was then taken over by the Department at Rs. 3-8-0 per maund. Altogether the Agricultural Department provided 1,021 maunds of seed for distribution in 1923-24, as noted in the margin.

Source.	Quantity in maunds.
Mirpurkhas Seed Farm 1922-23 stock	46
Mirpurkhas Seed Farm old stock	123½
District purchased through Messrs. Ralli Brothers ..	577½
Imported from Punjab ..	225

This however was only sufficient to meet a fraction of the demand which revealed itself in March, when it became known that irrigation facilities were promising.

The Department at this time endeavoured to meet part of this demand by importing seed from the Punjab, but March is too late in the season to undertake these operations as the seed of the previous crop is disposed of before this time.

A purchase of 50 tons of seed, however, was actually made on behalf of the Department, but it had to be rejected before taking delivery as it was found to be inferior and damaged from heating.

In future it would seem advisable to purchase seed in the Punjab in November-December as suggested in paragraph 36 above.

46. *Improved deshi cotton.*—The improved strain of deshi cotton isolated by the Department is known as "27 W.N." Seed of this cotton is available in small quantity. Altogether 346 maunds (including 75 maunds supplied to Middle Sind) were distributed in the year under report, of which about 100 maunds were issued to co-operative societies for propaganda purposes. The balance was issued to the marginally noted zemindars for the purpose of multiplication. It was hoped that these growers would be the source of a large supply of seed for the following season, but in practice it was found very difficult to secure pure seed from them for various reasons detailed in paragraph 34 above.

Name.	Village.	Quantity in maunds of seed.
Mr. Rochiram Tahilsing ..	Kathri	25
Haboo Kamgar ..	244 Deh of Mirpurkhas taluka	6¾
Mr. Tirithdas Manikram ..	Digri	20
Syed Md. Hussain Shah ..	84th Mile Jamrao ..	10
Lakha	Deh 110 Mirpurkhas ..	6
Syed Bandaishah ..	Deh 215 of 84th Mile Jamrao	10
Babu Ghulam Mahomed ..	Daulatpur.. ..	10
Lala Ramdittamal ..	Daulatpur.. ..	16½
Mr. Valiram Sachanand ..	Sinjhoro	10½
Sind Reclamation Co. ..	Tillashah	20
Babu Ghulam Mahomed ..	Deh 21 of Sinjhoro ..	20
Mian Shahbux ..	Deh 129 Mirpurkhas ..	10
Mr. Tilockchand ..	Tando Adam ..	15
Mr. Manohardas ..	Nawabshah District ..	5
Mr. Bulchand ..	Do. ..	5

The Divisional Superintendent of Agriculture was, however, successful in recovering 81 maunds of seed from the produce of fields in which special precautions had been taken to prevent mixture. In this case the growers agreed to sell their produce to Messrs. Ralli Brothers, who in turn kept it apart for separate ginning.

47. *Wheat Seed.*—The variety which has met with most popularity on the Jamrao canal is Punjab 11. This is a tract full of trees which harbour large numbers of birds, hence an awnless variety like Pusa 12

is not in favour. Punjab 11 on the other hand is awned and is a good yielder. In the year under report 738½ maunds were distributed; out of this quantity 405½ maunds were issued to Co-operative societies. The demand for seed was very strong and the Department could have distributed some 4,000 maunds of seed if it had been available. The irrigation facilities were satisfactory, and the yields obtained with this wheat were very good, and the public are now very keen on securing seed of this variety.

48. *Implements.*—Nothing has met with more approval than the Egyptian plough. This is a very good plough for use in conjunction with irrigation and its merits are fully described in leaflet No. 1. It has long been established in Mirpurkhas taluka and it is spreading into Sinjhoro, Jamesabad and Digri talukas and also part of Nara valley. The Department is now giving special attention to arranging with local mistries to take up the manufacture of these ploughs. The procedure adopted is to give a small advance to a mistri for the purpose of making and stocking a few of these ploughs. These are shown to customers and when disposed of the advance is recovered. In this way a demand springs up and the mistri deals with future orders without financial assistance. An important feature of this work is not insisting upon sticking rigidly to the exact specifications of the plough. If it is more convenient to use a bent pole of babul wood instead of a straight piece of jarrah wood then this is permitted, provided there is no important departure from the essential design of the plough. By this means the price of the plough can be kept very low not exceeding Rs. 4 to 5.

In this way orders for Egyptian ploughs are dealt with direct by the mistries who make them, and the Department distributes only a limited number. Thus direct purchases are now estimated at about a couple of thousand ploughs per annum.

49. Among the Punjabi colonists there is a tendency to go in for a light iron plough. The type which appeals to these people is a local imitation of the Meston plough. These are being made by a mistri in Jamesabad. The Agricultural Department is encouraging this man and co-operating with him in the sale of his ploughs. Between March and June of the current year orders for upwards of 100 of these ploughs were obtained, and the ploughs supplied, the purchaser making direct payment to the mistri.

This local made plough appears to be more satisfactory than the Meston plough manufactured by Messrs. Burn & Co. of Calcutta because the parts of the latter plough break readily, being made of cast iron; whereas the local plough is made of wrought iron which does not break although it may wear-out somewhat quicker.

It is anticipated that the modified Orient plough mentioned in paragraph 22 will meet with much favour among those who now favour this imitation Meston plough.

50. In connection with the popularization of these implements the propaganda staff have conducted a large number of village demonstrations. These are summarised in the margin. These demonstrations have been well attended and have created a good deal of interest. Discussions were held and in many instances, the visitors satisfied themselves by handling the implements themselves. These demonstrations led to a good sale of Egyptian ploughs, which were dealt with directly by the local carpenters. The Department however sold 55 Egyptian ploughs and a couple of dozen steel shares, and a few other implements.

Name of Taluka.	Name or No. of village.	Number of demonstrations conducted.
Jamesabad	299	1
	265	2
	309	2
	307A	2
	279A	1
Digri	153	1
	151	1
	150	1
	149	1
	154	1
	155	1
	Kangro	1
	148	1
	158	1
	170	1
	179	1
	Tando Jan Md.	3
	195	1
	190	1
	307	1
Mirpurkhas	Chandia	1
	Khial and 285	2

51. *Improved cultural methods.*—The most important piece of work under this heading is the sowing of cotton in lines. The advantages of this method of cultivation over the broadcast method have been fully explained in leaflet No. 27. It enables intercultivation to be done by bullock power whereas at present this operation is a very formidable manual operation in the cultivation of cotton. For this purpose demonstrations were conducted in the marginally noted villages. In connection with such work it is necessary in the first instance to provide from the Department a trained driller and pair of cattle, as the work requires a fair amount of skill. It is satisfactory to note that much of the area drilled in villages 128, 126,

Taluka.	No. or Name of village.	Area operated upon in acres.
Mirpurkhas	128, 126, 125, 127, 129	120
	244	6
Sinjhoro	21, 19	28
Digri ..	Tando Jan Md.	13
Jamesabad ..	Jamesabad.	16

125, 127 and 129, in the year under report, was done by the cultivators themselves as a result of departmental teaching in previous years. This drilling method of sowing cotton is particularly recommended for the lighter classes of soil and where the land is free from kalar salts.

52. Another cultural improvement which the Department is advocating is the cultivation of wheat by the " bosi " or semi-bosi system. This is the common method of cultivation in north Sind, but was not practised on the Jamrao until the Department demonstrated it. The method consists in storing moisture in the soil from kharif irrigation, so as to enable the wheat crop to be grown in the rabi season, without any irrigation to the standing crop. The system demands careful tillage so as to produce a fine mulch of dry soil which conserves the moisture in the soil below it. This method can be recommended wherever the soil is sweet and free from kalar salts, and it is obviously a very valuable method in a tract where rabi irrigation is precarious, as is the case on the Jamrao canal area. This method of course involves a greater effort in the form of more labour, but certain progressive zemindars are taking it up, notably Syed Sher Shah in villages 279 and 279A of Jamesabad taluka and in village 226 of Mirpurkhas taluka, and Ghulam Nabi Bozdar in village 244 of Mirpurkhas taluka. In the year under report these villages had from 25 to 30 per cent. of their wheat sown by this method. Zemindars are in the practice of giving their wheat crop on the Jamrao area as many as 5 or 6 irrigations if water is available. By adopting the bosi method of sowing this irrigation can either be wholly dispensed with, or the irrigations reduced to one or two according to the quality of the soil.

53. Another improvement is the introduction of gram on to the Jamrao tract. This crop is hardly known but it has been proved at Mirpurkhas that fair crops can be raised on sweet land. It is recommended as a substitute for wheat where irrigation is precarious, as it is grown on moisture conserved from the kharif season as described above, and the standing crop is better not watered on fine grained alluvial soils, such as prevail in this tract. As a result of propaganda a small area has been cultivated with this crop.

Middle Sind.

54. This area was organized as a separate division for propaganda in the year under report. For the present purpose, the area includes the Nawabshah and Hyderabad districts, but work is almost wholly concentrated within the cotton tract of these districts.

Apart from cotton the distinctive features of this tract are—

(1) the irrigation is mostly " lift ", supplied by numerous inundation canals which flow from June to September. The only exception is the Fuleli canal which is perennial ;

(2) there is a fine tract in the north of Nawabshah where wells abound, and much wheat is cultivated thereon ;

(3) the margin of the Indus river is cropped with wheat and other rabi crops according to the sailabi method, *i.e.*, the lands are under flood waters during the inundation season.

This tract is almost a virgin field for the Agricultural Department, as it has been very little touched in the past. An important feature of the conditions, is the very short period available for sowing crops. Sowings can not be started till June as the canals begin to flow about the end of May. On the other hand experience shows that cotton sowings to be fully successful, must be completed in June, and if possible early in June. Hence the lands have to be prepared in advance by dry ploughing and at sowing time it is essential not to waste time with elaborate tillage operations. Cultivation in the dry season demands an implement with a sharp penetrating share or tine, hence at present the scope for iron ploughs is more restricted than in east Sind where irrigation is available for a large part of the year.

55. The first operation undertaken in this division, has been to popularize an improved variety of deshi cotton (27 W.N.). About 6,000 lbs. of seed was supplied for this purpose, and out of this some 4,000 lbs. was given out in small lots to the khatedars of Hathri and adjoining villages. As this was the first season, each grower sowed only a fraction of his holding with this seed in order to satisfy himself as to the merits of the variety. At first those khatedars who are very critical, were inclined to disparage this cotton, but later in the season after watching its behaviour in the field, they became very favourably impressed with it. They noted that it was profuse in branching and bore a large number of bolls. At the time of picking the Department bought in some of the produce with the object of re-issuing the seed in the current season (1923). Altogether the area sown with this cotton was estimated at 130 acres.

56. In this division cotton seed grown in the neighbourhood of Bhitshah, a village in Hala Taluka, has a high reputation. This cotton consists of the same mixture of types as the rest of Sind deshi, but there has been a practice in this centre for banias to purchase specially picked seed-cotton and to gin this and sell the seed at a premium of 100 per cent. or more over the price of ordinary deshi seed. In detail the arrangement is as follows.

Pickers are engaged by zemindars to pick their cotton on the share system, generally 1/20th part. The bania then arranges with the pickers to pick separately the best opened bolls, and the zemindar allows the picker to take his 20th share from these specially well-opened bolls. In return for his trouble the picker who sells his share of the produce to the bania receives an additional price over the market rate, amounting to 3 or 4 pice per seer.

This special practice exists only to a limited extent in some half a dozen villages round about Bhitshah, and the total quantity of hand-ginned seed thus obtained is estimated to amount to some 1,000 maunds per season.

In the year under report and until the available seed of 27 W N is much multiplied, the Department decided to undertake the wider distribution of Bhitshah seed. This operation has been greatly facilitated by an arrangement with a local merchant who agreed to finance all the operations, so that all the Department had to do was to control the distribution without handling the cash.

Mr. Lokeram, the then Agricultural Inspector, drew up the conditions with the merchant and these may be summarized here:

(1) The seed is to be obtained from Bhitshah locality.

(2) The seed is to be taken only from the second or third picking—this eliminates the seed of late pickings which may have been damaged by cold weather.

(3) The seed is to be taken from the seed-cotton specially picked by the pickers as described above.

(4) The seed is to be hand-ginned.

According to these conditions, 250 maunds of seed have been secured—priced at Rs. 7 per maund against the rate of Rs. 8 for ordinary deshi. In addition another 1,200 maunds of seed obtained from Bhitshah, but ginned in the factory (with the machinery worked slowly) have been secured—priced at Rs. 5 per maund.

These two rates of Rs. 7 and Rs. 5 are the rates to be recovered from the public by the merchant. A thousand maunds of Bhitshah seed has also been supplied to East Sind.

57. Towards the end of February this Division passed into the control of K. B. Azimkhan, with Mr. Abdur Rehman as Agricultural Inspector. During the concluding months of the year the Agricultural staff were engaged in controlling the issue of the cotton seed referred to above and in addition conducted an active campaign in popularising agricultural implements. Village to village demonstrations were organised in over 60 villages in the marginally noted four talukas which have been selected for intensive agricultural propaganda. These demonstrations led to the sale of large numbers of ploughs, which was facilitated by credit given by the Co-operative Societies, but these operations will be reported upon by K. B. Azimkhan.

Hyderabad.
Hala.
Shahdadpur.
Tando Allahyar.

North Sind.

58. This division is also practically a new field for agricultural propaganda, as it has not been possible to give much attention to this tract until the year under report. Mr. Jaffurali held the charge throughout, until relieved by Mr. Lokeram at the end of February. This Division includes the districts of Larkana, Sukkur and Upper Sind Frontier and is very important. The main features are:

(1) There are upwards of 5 lakhs of acres under transplanted rice.

(2) There is a large area under "bosi" wheat, *i.e.*, wheat grown on moisture stored from the kharif season.

(3) Jowar occupies a large area in the kharif season.

(4) Several of the canals are fringed with lands devoted to excellent garden cultivation.

59. As the Department has made more progress with wheat than with other crops, seed of wheat was selected as the main item in the propaganda programme. Some 1,758 maunds of wheat seed was available for distribution, of which 1,565 belonged to the Pusa 12 variety. Upwards of seven hundred maunds of the latter was the produce of the wheat Farm at Jacobabad, and the balance had been purchased from seed growers. All this seed was distributed—about 616 maunds of Pusa 12 being located in the Sukkur Taluka.

The Pusa 12 seed produced on the Jacobabad wheat Farm in 1921-22 was distributed to the persons noted below in North Sind and 100 maunds was sent to Middle Sind.

Arrangements have been in progress since March to recover as much seed as possible from these growers and also from those who have grown this wheat pure from seed supplied from the general district grown seed which was reissued last autumn. In particular, special efforts have been made to recover all such seed produced in the Sukkur Taluka where the Department is engaged in intensive propaganda:

Name of seed grower.	Name of Taluka.	Quantity of seed supplied in maunds.
Dinalkhan Bicharji ..	.. Sukkur ..	50
Wadero Amir Bux ..	.. Do. ..	150
Gokalmal of Khahi ..	.. Do. ..	25
Syed Kutabali Shah ..	.. Do. ..	50
Wali Mahomedkhan of Gossarji ..	.. Do. ..	30
Pir Mahomed Khan ..	.. Do. ..	25
Nanumal of Gossarji ..	.. Do. ..	15
Hussainali Khan ..	.. Do. ..	2
Abdul Karim Khan ..	.. Do. ..	2-14
Hasanand Bulchand of Jogan ..	.. Shikarpur ..	40
K. B. Dur Mahomedkhan ..	.. Garhi Yaseen ..	40
K. S. Chakarkhan ..	.. Kandhkote ..	20
K. S. Dilmuradkhan ..	.. Jacobabad ..	200
Kaiserkhan of Nasirabad ..	.. Do. ..	30
Wadero Nabibux of Akilpur ..	.. Do. ..	2-20
Abdul Khaliq ..	.. Thul ..	7-20
	Total ..	689-14

60. This is a very fertile taluka in which excellent wheat is grown, much of it rotating with market-garden crops. Such lands are well suited to a wheat like Pusa 12 which responds to good treatment. From all accounts this wheat has given much satisfaction to the grower, and there is now a clear course for the rapid spread of it. It is hoped that practically the whole taluka will specialize in this wheat and serve as a seed-supply source for the north of Sind. Although every effort is being made to

recover as much seed as possible for next season's sowings, still it is not anticipated that more than 3,000 maunds will be purchasable. The most effective way to fill this taluka with Pusa 12 wheat would be to make a large import of seed from the United Provinces, of say 5,000 maunds of seed. This suggestion is now receiving consideration. In the meantime K. B. Azimkhan, Assistant Registrar of Co-operative Societies, has been successful in arranging with local merchants to purchase the Sind grown Pusa 12 wheat, and to store it and issue it next autumn to the villages selected by the Department.

If this scheme works successfully it will save Government both the labour of handling the seed and the financing of the operations.

In the season under report there was a general outbreak of yellow rust which attacked all local wheats but Pusa 12 remained immune, and this valuable character has been fully recognised by the growers.

61. The second piece of work undertaken in this Division has been the demonstrating of improved implements.

Village to village demonstrations have been conducted by the Agricultural Overseers. One party made an itinerary in the Sukkur Taluka from the 1st December to mid-February, visiting eleven villages. Fairly long halts lasting several days were made in each of these villages. The implements demonstrated were light iron ploughs including the Rajah and Sirdar. In these villages valuable crops are grown including areas of sugarcane and market-garden crops, and apart from canal irrigation in the kharif season, there are upwards of 2,000 wells. Hence there should be an opening for ploughs of a superior type. As a result of these demonstrations sales of ploughs and chaff cutters to the value of Rs. 678 were effected. The most suggestive development, however, was the disposition of the people to hire these implements, or even to pay so much an acre for ploughing. The Department with a view to testing the field in this direction agreed to plough land with the Rajah plough at the rate of Rs. 6 per acre and there was an interesting response to this offer in the marginally noted villages. Altogether 14 acres of land were ploughed and Rs. 79 recovered in charges. This indicates the line which should be taken in this locality and it is proposed to organise sub-depôts where implements will be hired out, as well as a few stocked for sale.

Rahuji.
Gossarji.
Jahan Khan.
Napar.
Miani.
Khahi.

62. Another piece of machinery which the people took great interest in was a small iron sugarcane mill. Crushing is done in a very primitive manner, similar to the method adopted for crushing oil seeds. Mr. Jaffurali, the Agricultural Inspector, soon sold nine "Hathi" mills worth Rs. 1,182-8-0. He also adopted the system of hiring, and found it quite easy to recover 8 annas per day rent for a small mill. In one case a rent of Rs. 44 was recovered on a "Hathi" mill for a month and a half's hire. It is estimated that the iron mill crushes a maund of cane at a cost

of 4 pice, whereas the cost by the local method is reckoned at 15 pice. Extraction by the local method is only 52 per cent. against over 60 per cent. by the "Hathi" mill.

The people however are not quite satisfied with this type of mill as there have been some breakages, and the Department is engaged in finding out a stronger mill. The Chattanooga mill (Number 12) costing Rs. 340 is found to be rather too heavy, as the cattle are on the small side.

63. The Poona furnace and gul making method was demonstrated in the Sukkur Taluka in December by a couple of trained men from Poona, and the quality of the gul met with much approval. The marginally noted Hindu khatedars have adopted this method and have built furnaces and purchased pans. The people realize that there is a great saving in the cost of preparing gul by the Poona method. It is estimated that a maund of gul prepared by the local method costs Rs. 2-11-9 while the cost by the Poona method is only 6½ annas, while the gul obtains a premium of one rupee or over per maund.

Gokalmal .. Khahi
Dayarsing .. Do.
Ladhomal .. Do.
Jashanmal .. Do.
Newandmal .. Do.
Sobhomal .. Murgrain
Gobindram .. Napar

Drilling Jowar Seed.
Rice seed economy.
Winter ploughing of rice land with iron ploughs.

64. The staff in this division has also been able to give some attention to the marginally noted works.

65. At the end of February this Division was taken over by K. B. Azimkhan, and Mr. Lokeram became Agricultural Inspector, and since then, work has been concentrated in the four marginally noted talukas. Most of the time of the staff has been occupied in recovering seed for next season's sowings and in making arrangements for kharif demonstration operations.

Sukkur.
Ghotki.
Kamber.
Larkana.

T. F. MAIN,
Deputy Director of Agriculture.

APPENDIX H.

Summary of Work on Agricultural Propaganda in North and Middle Sind, January to June 1923, under the Assistant Registrar of Co-operative Societies, Sind.

1. In accordance with Government Order No. 5805, of 10th January 1923, the following eight talukas were assigned to me for carrying on intensive agricultural propaganda work :—

North Sind ..	.. Ghotki. Sukkur. Larkana. Kambar.
Middle Sind. ..	.. Shahadadpur. Halla. Hyderabad. Tando Allahyar.

North Sind.

1 Agricultural Inspector, Mr. Lokram.
3 District Agricultural Overseers.

Middle Sind.

1 Agricultural Inspector, Haji Abdul Rahman.
3 District Agricultural Overseers.

I took charge of my new work on 20th January 1923 and with the marginally noted staff set out to execute the propaganda programme which mainly was to—

(1) Popularise and distribute approved varieties of seed.

(2) Popularise and distribute approved agricultural implements.

(3) Propagate modern methods of farming.

(4) Organize taluka development associations with a view to facilitate the execution of the above activities.

2. *Seed supply and distribution of wheat.*—In September last I was offered the agricultural propaganda work at Poona and on my return immediately proceeded to Upper Sind and took to distribution of Pusa 12 wheat which was known in the Agricultural Department to be of very superior quality. About 800 maunds were for the first time distributed in Sukkur, Ghotki, and Pano Akil talukas, and about 200 maunds in Middle Sind. The zamindars were at first hesitating to introduce the seed in their fields as they were quite ignorant of it before. During the course of its germination and growth, however, the following properties came to light, *viz.*, that—

(1) It is rust resistant.

(2) It ripens earlier.

(3) It is more delicious than local varieties.

(4) It is denser in substance.

(5) Being superior in quality it naturally fetches higher value.

The zamindars, therefore, appreciated the seed very much, and are not willing to part with it even though a premium of annas 5 to 8 per maund is offered to them. Out of the produce of 1,000 maunds of this quality distributed by me among the zamindars during last Rabi a greater portion went to Haris in Batai, some portion has been retained by the zamindars as seed, and some they consumed as food. The usual practice about financing of Pusa 12 seed was to purchase it departmentally at harvest time and sell it out to zamindars in the sowing season. This practice was of a very complicated nature, as it involved too much account keeping by the Department and correspondence. Besides if the prices fell the Government had to sustain loss. I therefore negotiated with a Sethia of Sukkur (Seth Tilokchand) who agreed to purchase and store Pusa 12 wheat and distribute it in the ensuing Rabi under orders of the Department. At Ghotki and Jacobabad also I made similar arrangements with local zamindars. So far about 2,000 maunds have been purchased and stored in addition to the quantity available at our own agricultural farms.

Last year, experience has shown that it is very troublesome to sow patches of 12 Pusa wheat in scattered dehs and among small khatedars. Apart from the difficulty of supervising these crops, there follows a greater difficulty of collecting the seed dues and the multiplied seed. I have, therefore, decided this year to distribute large quantities of Pusa 12 among big landholders or at any rate in big compact areas so that supervision, collection of dues and the multiplied seed may be comparatively an easier business.

To supplement the available quantity of Pusa 12 in order to meet the total requirments of this year, I had intended to send down a departmental officer to the United Provinces with a view to negotiate direct importation, but the quotations of United Provinces are nearly double those of Sind. I am afraid, therefore, that this year I shall have to rest content only with that quantity of wheat as may be raised locally and from the agricultural farms. If the quantity of Pusa 12 reserved by the zamindars themselves to be used as seed during the next *rabi* is also taken into account, the quantity of seed available for next *rabi* would come to 5,000 maunds nearly.

3. *Cotton.*—Two varieties of cotton seed were distributed for this *kharif* season, *viz.*, 27 W.N. and the "Bhitshah" seed. Of the first quality only about 300 maunds were available in the whole department, of which 100 maunds were given to me and 200 were utilised in the Dhoro Scheme. A greater portion of the quantity given to me was distributed among co-operative societies in the Hatri Union. The area sown with this seed has since been cursorily watched. Germination on the whole is only fair, resowing of patches being necessary in several places. So far the stand is even and full in better class of soil. The entire cost of seed has been recovered and credited to the department. A little mixture of about 1 per cent. American cotton has been found in this crop which is being weeded out at once, under the supervision of the Department.

The Bokhro disease was universal on the germinated cotton of all sorts and 27 W.N. did not escape the evil. The zamindars at first endeavoured to resow the patches with ordinary seed but the Department had to put in great efforts to stop the malpractice.

Bhitshah Cotton Seed.—Bhitshah cotton is a variety of reputed cotton in Sind. The ginneries pay a premium of Re. 1 to Rs. 2 per maund over this variety.

It has a ginning percentage of about 40 and yielding qualities higher than the ordinary Sindhi cotton. The 27 W.N. variety not being available for supply I made arrangements with Seth Radhkishen Kundomal, a big Sethia of Tando Adam of Shahadadpur Taluka, to finance and supply this seed. The department undertook to inspect that the seed cotton used for ginning was from the selected picks of " Bhitshah " crops and that the ginning was regulated at proper speed to avoid breakage of seed. After ginning the seed, it was further sifted of dust and other impurities. Indents for this seed were collected and distribution undertaken by my staff. About 2,000 maunds of Bhitshah seed were in all distributed in four of the cotton growing talukas, *viz.*, Halla, Hyderbad, Tando Allahyar and Shahadadpur. The germination from this seed has been excellent, and zamindars who have sown it have expressed both written and oral satisfaction. Apart from having better germination the zamindars report to have effected much saving in the seed rate. Usually they put 40 to 70 lbs. per acre but 20 to 25 lbs. of machine ginned Bhitshah have been found to give sufficiently thick stand of the crop, and only 12 lbs. of hand ginned Bhitshah were put in an acre with equally good germination.

In several cases seed was delivered at the zamindars' villages or at Railway stations nearest to them. Seed depôts were also opened at taluka headquarters for retail sale. When germination reports of the first consignment got abroad there was a great rush for the seed and the stock was exhausted immediately.

American Cotton.—An area of about an acre has been for the first time tried near Tando Allahyar with the American cotton. It is doing well so far. The required seed was obtained from Mirpurkhas.

4. *Indents for other seed.*—Zamindars round about the town of Hyderabad have come to realise that Berseem fodder is a paying crop and following indents have been obtained for it. The price of the required quantity is generally recovered in advance and remitted to the Deputy Director of Agriculture as under :—

	Lbs.	Rs.
(1) Mr. Mangharam D.	400	200
(2) R. B. Rijumal Thadani	40	20
(3) Mr. Jagtiani	400	160

		Lbs.	Rs.
4.	Diwan Kishenchand A.	320	160
5.	Mukhi Harkishendas	120	60
6.	L. H. Richards, Esq.	80	No advance.

Inquiries for Lucerne and guinea grass seed have been received and suitably attended to. Arrangements for the supply of hot and cold weather vegetable seeds to the suburban gardens have also been made.

5. *Demonstration of Improved Implements, their Manufacture and Distribution.*—Village to village demonstrations were held with the Rajah, Orient, Monsoon, Meston, and the Egyptian ploughs. In all about 100 villages and hamlets were thus touched during the period. Moreover 8 big central demonstrations at the headquarters of all the 8 talukas assigned to me were organised, wherein our implements were worked side by side with the local ones. Our ploughs with the exception of the Rajah and the Monsoon worked by ordinary pair of bullocks in the soil chosen by the zamindars proved superior and commanded high appreciation in the end. On the whole the Egyptian plough has been universally accepted by the people and as a result of these demonstrations indents for these ploughs were pouring in a large number and 465 were actually sold during the period.

Negotiations were, therefore, entered into with firms at Hyderabad and Sukkur to manufacture these ploughs and other improved implements. The carpenters of the firms were trained in the manufacture of these implements and the firms were given all conveniences and instructions from time to time as to measurement of several parts and the kind of wood to be used. These works are from time to time supervised to see that their outturn is satisfactory, as regards workmanship, material, daily output, etc.

Besides the Egyptian plough a demand has been created for several other implements, *viz.*, scrapers, clod crushers, drill tubes, ridging boards, Meston ploughs, etc. Owing to poor inundation this year just at the sowing time some flow areas stopped receiving water, when our hand Archmedian Screw lift came to the aid of the cultivator. This is very handy water lift, easy of fixture and transport, giving about double the quantity lifted by a local Hurla. It is worked by hand. Working demonstration in these are going on and enquiries about them are pouring in. Several zemindars request the lift to be experimentally worked on their own fields. Owing to want of funds, however, it has been possible to do this only in very few places. In spite of that orders for nearly one dozen of these screw lifts were received which have since been executed. Other orders are coming in and the screw lifts are in the course of construction.

6. *Practical demonstrations in improved methods of farming.*—With a view to bring home to the agriculturists the superiority of improved

methods of farming I secured plots from zamindars in the various talukas and arranged for their cultivation with the following results :—

(*a*) *Drilling demonstration in cotton.*—In all more than a dozen plots had been secured on private fields in Middle Sind to show drill methods, but owing to poor inundation only 10 plots of area varying between 1 to 2½ acres were actually organised and drilled in talukas Hyderabad, Shahadadpur and Tando Allahyar. The seed drilled in all cases was 27 W.N. except about 1½ acres in plot No. 1, which is sown with hand ginned "Bhitshah" for comparison sake. We had to contend with many difficulties in going through the programme of the above demonstration plots, scarcity of water being the most unsurmountable one. With every fall of the river the water courses ceased to run and consequently water from the plots was cut off. Besides we had to do two resowings in almost all the plots as the germination of 27 W.N. was not very satisfactory, the seed supplied to me being mostly of a poor quality.

Apart from drilling the above plots directly by the Department, trained staff assistance was also rendered to other big zamindars, who put about 5 to 10 acres of land each under drill-method by their own labour either trained or supervised by the departmental staff. Interculturing of the drilled plots has already commenced.

(*b*) *Practical demonstrations in rice cultivation.*—About ten plots were secured from zamindars in Larkhana and Kambar talukas for demonstrating each of the following improvements in the rice cultivation, Larkhana and Kambar being chiefly rice growing talukas :—

(*a*) Reduced seed rate *versus* ordinary seed rate.

(*b*) Earlier transplanting *versus* ordinary transplanting.

(*c*) Bengal variety *versus* local varieties.

Each of these points may be dealt with as under :—

(*a*) There are about 68,000 acres under rice cultivation in Kambar taluka and about 54,000 in Larkhana taluka. The average seed rate is 1 maund per acre but our department demonstrated with ½ the quantity. Results so far are favourable and would be finally known when the crops are harvested.

(*b*) The advantages of earlier transplantation of seedlings have been fully brought home to the agriculturists and may be briefly summarised as under :—

1. The course of the Indus being notoriously capricious earlier transplantation ensures the crops against a premature fall or sudden diversion of the river.
2. It offers even distribution of labour regarding sowing in nursery bed, transplanting, harvesting, etc.
3. It assures better yield and better prices.
4. It enables earlier crops and thus liberates the soil in time for dubari (2nd) crop.

(c) The distribution and plantation of the Bengal variety is a pretty new introduction. The results have to be marked when the crop is actually harvested, but Mr. G. M. Isani, Deputy Collector and a big zamindar of Garhi Yasin taluka, claims for it that (1) it yields much higher than all the local varieties of rice, (2) it is delicious like the *Sugdasi*, (3) it requires only 5 seers per jireb, *i.e.*, only one-quarter the ordinary seed rate to its profuse tillering capacities.

7. *Combat with crop pests.*—Several inquiries regarding cotton pests have been received and general precautionary or available remedial measures have been suggested to the zamindars. Any extended programme of work in this direction cannot at present be executed for want of funds, or known methods of combating the diseases.

Complaints of rats doing damage to onion and wheat fields were received from several places. Help in the shape of supplying poison and demonstrating its use was immediately rendered. The zamindars have expressed great gratification.

8. *Taluka Development Associations.*—With a view to facilitate the work of intensive agricultural propaganda, Taluka Development Associations have been deemed to be very useful organisations. I have, therefore, organised eight such institutions, one for each of the eight talukas assigned to me. The following five of them have recently been put into working order while the remaining three are still engaged in collecting funds. Their actual work would, so to say, begin from the next cultivation season; 1, Kambar, 2 Ghotki, 3 Larkhana, 4 Tando Allahyar and 5 Shahadadpur.

AZIMKHAN,
Assistant Registrar, Co-operative Societies, Sind.

APPENDIX I.

Work done under the Professor of Agriculture, Poona, during the year 1922-23 June 30th.

Staff.

1. I remained in charge of the office of the Professor of Agriculture throughout the year. Mr. K. S. Kulkarny, B. Ag., Lecturer in Agriculture and Superintendent of the College Farm, was on leave for a month and 12 days during the summer vacation. No substitute was employed during his absence. There were no other changes in the staff.

Agricultural College Farm.

2. *Area of the Farm.*—Upto the end of the year under report total area of the college estate stands at 248 acres. The actual area under cultivation is however about 110 acres, the rest having been occupied by college and the farm buildings, roads and area unfit for cultivation as well as by the Modi Bag gardens. An amount of extensive development work has been taken up and embankments big and small have been put up wherever it has been felt protection was necessary to prevent scouring and washing off of soils and to reclaim areas cut up by big and small streams. This will add considerably to the value and usefulness of the land in course of time and fit the areas treated for cultivation. A piece of garden land of about 32 acres is yet under the process of acquisition. This, when acquired, will be a very good asset and help the teaching work a good deal.

3. *Health of the Estate.*—Except for the appearance of plague the general health of the estate was on the whole good. During the epidemic all inhabitants were inoculated and everything went safe except for two deaths amongst the farm labourers, one having been inoculated too late and the other having escaped it altogether.

4. *The Season.*—The season was on the whole precarious. The total rainfall from June to November was 15·70 inches. After that month there was no rain at all that one could call as helpful except for a few showers (1·38 inches) in March which did more harm than good to cotton and other standing crops. Sowings began on the 30th of June and there was continuous wet weather for more than a month and a half and this was particularly troublesome from the point of view of intertilling. Then from 24th August to 9th October there was a continuous dry spell of over a month and a half and it was a very trying time for most crops. But this served extremely well to demonstrate to the students the importance and effectiveness of thorough tillage. This very long dry spell had, however, its effect on Jowars which were greatly handicapped at the time of flowering and this reflected a good deal in the outturn of grain. Cottons and other crops, however, kept quite well. The rainfall that came on the 9th November, however, proved extremely helpful to cottons and for the *rabi* crops but did considerable

damage to Bajri, Jowar and other crops which were all ready for harvest or harvested. *Rabi* crops grew well only to be again spoiled by the very untimely rain in March about the time of harvest.

5. *Teaching.*—The staff on the Agricultural College Farm have had their hands quite more than full with the college teaching and the farm management besides.

There has been a radical change made in the cropping for the year 1923-24 for Senior B. Ag. students. A number of crop varieties mainly of Jowar, cottons, and wheat were being grown so far for demonstration. But many of the varieties were found unsuitable for the conditions obtaining in Poona, and hence they used to be non-profitable. The varieties, therefore, have all been limited to the object lesson area and the main cropping has been restricted to such crops and varieties as do grow well under the conditions obtained here. Some useful and convenient rotations have also been fixed in the light of past experience. Effort has been made to manage the crops on economic lines. The results are closely watched with interest. It is expected also, on getting the new area of about 35 acres of garden land near by, to institute a section of the farm run purely on commercial basis. The change in the present area coupled with the scheme in the new area to be acquired will, it is hoped, be a great help to the students to get practical insight into commercial management of a farm.

Junior students did not have their own individual area but learned all the farm operations by a set of exercises on an area set apart for them. This season each student is allotted 2 guntha plot of cotton as *kharif* crop and 2 guntha of onion as a *rabi* irrigated crop and students will get the outturn of their plots for themselves. This will induce them to take real interest in their work.

6. *Other Work.*—The farm has been always called upon to act as central bureau by farmers from various parts especially in the matter of supply of improved implements and seeds. This, specially the distribution of implements, had a severe check in recent years during and after the war owing to very high prices. Prices have now fallen down a good deal, though yet far above pre-war prices. This part of the farm activity has shown an increase during the year under report. As regards the supply of seeds considerable work has been done in supplying seeds like *sann* hemp, fodder jowars, cotton seeds, groundnuts and orders for seeds of vegetables, lucerne and so on, have been directed to proper and reliable agencies.

The Agricultural College Dairy, Kirkee.

7. Messrs. S. M. Patel, B.Ag., and H. Ezekiel, B.Ag., were on deputation to Palghar as Joint Managers of the Infant and Public Milk Supply and Co. Dairy Farm, Palghar, and the former returned to his duties here on 16th November 1922. Mr. S. M. Patel was on leave from 18th April to 14th May during the year. No substitute was employed.

I am glad to note that the pressure of Manager's duties was greatly relieved by the return to the Dairy of an already experienced hand, Mr. S. M. Patel, with an increased experience of management at the Palghar Dairy Farm.

8. *Dairy Herd.*

STRENGTH AND VALUATION.

Class of animals.	Strength on 1st April 1922.	Valuation on 1st April 1922.	Strength on 1st April 1923.	Valuation on 1st April 1923.
		Rs.		Rs.
1. Cows	30	6,370	43	9,200
2. Cow breeding bulls	5	615	2	300
3. Cow heifer calves	30	3,850	30	2,850
4. Cow bull calves	24	1,790	20	1,450
5. Buffaloes	56	9,960	64	11,135
6. ,, breeding bulls	3	210	2	160
7. ,, heifer calves	48	5,380	53	4,270
8. ,, bull calves	2	100	6	140
9. Bullocks	19	840	26	1,810
10. Horses	2	285	2	250
Total ..	219	29,400	248	31,565

9. *Breeding.*—The herd consists of Sindhi cows and Gujarat buffaloes (Surati).

The breeding of certain strains of Sindhi cows is continued and we find Zankar's strain is giving promising results and the other strain of Begum was also under observation but the results did not come to expectation as shown below.

Zankar.			*Begum.*		
3,117 lbs. average of 14 years.			2,379 lbs. average of 11 years.		
Changuni. 3,741 lbs. 7 years	*Sire*	Battasha.	Beatrice 2,310 lbs. 2 years 8 months	*Sire*	Daulat.
	Dam	Zankar.		*Dam*	Begum.
Chrissie 3,590 lbs. 2 years 11 months	*Sire*	Daulat.	Betsy 884 lbs. 1 year 3 months	*Sire*	Pitambara.
	Dam	Changuni.		*Dam*	Begum.
Amy 3,894 lbs. 1 year 11 months	*Sire*	Pitambara.	Belle 1,444 lbs. in five months	*Sire*	Gopia.
	Dam	Changuni.		*Dam*	Begum.
Clarissa 3,316 lbs. 1 year 3 months	*Sire*	Housha.			
	Dam	Changuni.			

The other strain that we are now building up by line breeding from the sire line that is Housha is that of Barabara and her daughters.

Barabara 3,888 lbs. 2 years 7 months	*Sire*	Housha.	Barshi 1,421 lbs. in four months	*Sire*	Shivaji.
	Dam	Cassandra. 1,106 lbs. 2 years.		*Dam*	Barbara.

Though we have lost Housha at the age of 16 years still we have bulls from his blood and one King Arther aged 2 years from Housha and Amy (Zankar's strain).

The average performance of some of the other high yielders for the period under observation is as follows :—

Names.	Year under observations.		Average annual yield of milk.	Remarks.
	Years.	Months.	lbs.	
Cows.				
1. Susan	1	..	3,921	Home bred.
2. Aurelia	4	..	3,764	,, ,,
3. Rebecca	1	2	3,751	,, ,,
Buffaloes.				
1. Louise	4	3	4,419	Home bred.
2. Rhoda	1	7	3,801	,, ,,
3. Sajani	17	..	3,200	Purchased with mother.
4. Mehsana	1	..	4,030	Purchased.
5. Abu	1	..	3,966	,,
6. Deesa	1	..	3,580	,,

The annual production of milk and the price realised per 100 lbs :—

Year.	Total milk produced.	Total fed to calves.	Total Sale.	Money Realised.	Price per 100 lbs. milk.
	lbs.	lbs.	lbs.	Rs.	Rs.
1921-22	199,212	22,297	176,915	24,432	13·81
1922-23	249,009	14,513	243,496	49,269	21·01

In 1922-23 the milk yield has increased by 19·89 per cent. over the previous year and the money realised per 100 lbs. has also increased by 52 per cent. over the previous year. The cost of milk production works out to annas 3 pies 5·5 per pound of milk.

11. *Fodder Production.*—The dairy possesses 338 acres of land at the Manjri Kuran and the college dairy, out of which only 130 acres are under cultivation. Out of the 45 acres cultivated area at the college dairy 17 acres were cropped thrice, 13 acres twice, 11 acres once, and 4 acres were under guinea grass. The average yield of fodder per year is 22,329 lbs. green per acre on the above area. The cost of production per 100 lbs. green fodder is 9·04 annas as against 12 annas in the previous year.

Statement of Fodder Production at the Dairy, Kirkee.

Kind of crop.	Total acres during the year.	Total yield during the year.	Average yield of green fodder per acre during the year per crop.
	A. g.	Lbs.	Lbs.
Maize	63 36	573,163	8,939
Nilwa	6 37½	155,237	22,199
Shalu	7 18	86,274	11,576
Oats and peas	3 17	65,378	19,088
Guinea grass	3 36	102,443	25,497
Carrots	.. 20	14,000	28,000
French bean	1 33½	8,320	4,528
Total ..	87 38	1,004,815	11,424

The old Kuran area of about 26 acres that was given away to Manjri Sugarcane Farm for sugarcane in 1919 is returned in the beginning of June 1923. It is therefore expected that in future there will be no need for purchasing fodder, but on the contrary we hope to build up some reserves of fodder storage.

The reorganisation scheme for working the Dairy on commercial lines has been successful as can be seen from the following figures.

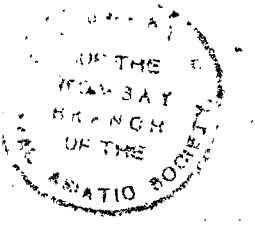
Year.	Expenditure.	Receipts.
	Rs. a. p.	Rs. a. p.
1922-23	58,449 1 0	61,340 12 0

This leaves a profit of Rs. 2,791 on the year besides paying for the teaching requirements at the college which are estimated to cost Rs. 4,600.

The Manager Mr. Baluch, and the Senior Assistant Mr. S. M. Patel, deserve credit for carrying out the details of the scheme.

The question of running the Dairy for profit, however, is not yet finally settled. It will require a few years' careful working to make it really a profitable concern.

B. S. PATEL,
Professor of Agriculture.



APPENDIX J.

REPORT OF THE WORK OF THE AGRICULTURAL CHEMIST FROM 1ST JULY 1922 TO THE END OF 30TH JUNE 1923.

During the year under report I was in charge of the Office and Laboratory of the Agricultural Chemist to the Government of Bombay, Poona, except the period between the 5th of April and the 25th of May when I was on leave and Mr. N. V. Kanitkar, M.Ag., B.Sc., held charge of the post.

2. The work under me may conveniently be divided into five sections for report. They are—(1) Analytical Work, (2) Investigation work, (3) Teaching at the Agricultural College, (4) General supervision of the Manure Laboratory attached to the Union Agency and (5) Water-finder work.

Analytical Work.

3. The number of samples received during the period under report is given below.

	Government.	Private.	Total.
Soils	377	95	472
Waters	313	63	376
Manures	75	92	167
Feeding Stuffs	85	48	133
Fruits and Vegetables	40	3	43
Cocoanuts and Coccanut cakes	....	69	69
Oils	11	....	11
Gul	....	1	1
Dairy products	4	36	40
Miscellaneous	36	64	100
	941	471	1,412

In addition to these, 30 samples of sugarcane juice, 40 samples Megass, and 20 samples of Gul were analysed for the Manjri Experimental Farm.

4. The Government samples analysed show the work which the Laboratory is doing to help workers in the other branches of the Department in their investigation, thus helping although indirectly in solving the various problems the Department is working at.

5. The real test of the success of the Laboratory as supplying a public need is best shown by the use which the public make of this laboratory. A large number of samples are received from the actual cultivators and from men engaged in industries depending on agriculture. Usually the number of samples received fluctuates between 350 and 450. In the year under report there were 471 samples received.

6. The character of most of the samples was just the same as in former years. The majority of the soil samples from private persons were from

lands that do not yield the usual outturn or have degenerated in recent years. The water samples in most cases were for determining the salts to find out if the waters were in any way injurious for irrigation. In the year under report as many as 92 samples of manures were received from actual cultivators and manufacturers. In the last year's report it was pointed out that many times the manures were adulterated. It is, therefore, a good sign that the people are beginning to feel the necessity of getting their manures analysed before using. Nowadays there are several mixtures on the market sold as fertilisers for sugarcane. Many of these are mixtures of oil cakes and ammonium sulphate. Oil cakes and ammonium sulphate in mixture form excellent manures for sugarcane but the samples on the market at present usually contain only 5 to 6 per cent. nitrogen. Many of the safflower or *kardi* cake samples received were from undecorticated seed. This material contains about 2·5 per cent. of nitrogen while the cake from the decorticated seed contains about 6 per cent. nitrogen. The agriculturists should note this in buying the *kardi* cake. A sample of guano received from a firm in Bombay contained 27·8 per cent. of phosphoric acid.

7. Many of the grasses found in the Bombay Presidency were analysed in former years, but it was found that some important ones were left out. These, about 13 in number, were analysed at the request of the Economic Botanist.

8. At the instance of the Director of Agriculture spear grasses from Bankapur and Chharodi Farms, from the mal-lands of Sholapur and Satara and also from Tegur were analysed. It seems from the results obtained that these spear grasses of the various places are not the same in their food value.

9. Samples of *kodra* seed were received in connection with their poisoning effects and it seems, from the importance of the crop, that it should be taken up by the Agricultural Department as a special problem for study.

10. Some grasses reported to have caused night blindness in bullocks were analysed and were also examined by the mycologist to find out if there was any fungus attack. These grasses were old and had in some cases deteriorated in their feeding value but there was no poisonous material developed. Three years ago similar complaints were received about the grasses causing night blindness in horses. All these complaints seem to be due to want of nutrition in the foods. The horses actually recovered their sight when the rainy season had sufficiently advanced, as they then received green grass. The only remedy in such cases is to feed a small quantity of green material to the animals.

11. A sample of artificial ghee received showed that it was animal fat with a small quantity of oil to give a slight yellowish tinge to the material so that it may look like ghee.

12. The Economic Botanist is trying experiments to find out a suitable method to destroy the lantana, which has become a very bad pest in some forests. In one of his experiments he poured sodium arsenate

solution in a hole made at the base of the stem and then plugged the hole. The plant so treated withered and died in about a week. The roots, stems, branches, and leaves were analysed to find out how the poison spread. It was found that the poison spread all over the plant.

Investigation Work.

13. A short report of the chemical study of soils and waters in connection with the red rot disease of sugarcane at Amalsad which was reported last year as completed has been published.

14. A report of the chemical work done in connection with the preparation of *gul* from cocoanut palm juice has been written and sent to the Deputy Director of Agriculture, Konkan, for being included in his publication on cocoanut palm juice.

15. A note of the work on the utilisation of the mowhra flower refuse after distillation has been written and will soon be published.

16. The work done in studying the various changes in the chemical constituents of the rice plants at different stages has not yet been written out but the results will soon be put together.

17. As indicated in the last year's report experiments in connection with the manuring of the rice crop were taken up. They will be repeated in 1923-24 to confirm the results already obtained.

18. The work in connection with the improvement of the cardamom crop is continued by Mr. G. M. Bapat under the Sir Sassoon David Trust Fund. The special feature of the work during the period under report was the study of the life history of the protozoa found in the soils and the relation of these protozoa and their excretion to the badness of the soil.

19. Mr. N. V. Kanitkar, Acting Assistant Professor of Chemistry, is carrying on his village survey work to study the economic condition of the villages. This year he had taken up the study of Posari village near Karjat.

20. Two new problems have been taken up. One to study the changes in the nitrogen content of the soil in connection with the cotton growing experiments which are being carried out at Surat. The plants grown on the ridges do better than those grown on flats. It is intended to find out whether this difference has anything to do with the changes in the nitrogen contents of the soil. The second problem is to find out whether the soils in the Deccan are able to recuperate their nitrogen contents and if so what conditions are most favourable for such recuperation.

Teaching.

21. I was responsible for the teaching of Geology and Chemistry to all the classes of the College. The teaching work has become very heavy in recent years, but I am glad to say that every one of the teaching

staff in chemistry section is carrying on some research work in addition to the teaching work of 20 to 22 hours a week.

Manure Mixing Factory.

22. According to Government Order No. 7790, dated July 27th, 1918, R. D., a Chemical Laboratory is attached to the Union Agency with a view to encourage the use of manures by preparing mixtures of manures for the various crops. Mr. V. N. Gokhale, B.Ag., B.Sc., was in charge of this Laboratory during the period under report.

23. The analytical work done in this Laboratory includes soils and manures sent by the Union Agency in their usual dealings as also the manure mixtures which they prepared. The total number of samples analysed was 73 and may be classified as follows :—

Soils	14
Organic manures including oil cakes ..	23
Mineral manures	13
Artificials	7
Manure mixtures	16
	73

Mr. V. N. Gokhale's services were utilised for College teaching work during the month of June.

Water-Finder Work.

24. For a long time it was a practice to depute one of the assistants from the chemical Laboratory to work with the water-finder machine for about 8 months in a year and to appoint a substitute during this period to work in the place of that assistant. A special sanction was every year obtained for this temporary appointment. But during the last two years the temporary post was not sanctioned and the work was done at great inconvenience to the Laboratory where there is a regular rush of samples for analysis.

25. Last year it was settled to try and find out whether the demand for the water-finder remains even when a charge is levied for the use of the machine. During the year under report a fee of Rs. 10 for the first two days and of Rs. 5 for every succeeding day was charged. When the machine was used for wells of non-agricultural type charges for travelling also were made. Even with the fees charged it must be said that the calls for the water-finder were more than could be attended to.

26. The year under report could not be fully utilised for water-finder tests. There were rains in November and part of December and the work was started one and half month later than usual. Then again in March and April the assistant in charge of the machine was held up at several places on account of the cloudy weather.

27. In all Rs. 286-2-0 were received as charges for the water-finder work. The following table gives a clear idea about the work undertaken.

Name of the District.	Number of villages visited.	Number of persons or institutions.	Number of spots tested.	Number of spots where indications of water-current were given.
Ahmednagar	1	1	4	1
Belgaum	1	1	4	1
Bijapur	3	2	15	3
East Khandesh	1	1	4	1
Kolaba	1	1	6	....
Nasik	3	4	17	1
Poona	11	10	56	8
Ratnagiri	1	1	5	....
Satara	3	3	15	3
Thana	1	1	5	1
Total ..	26	25	131	19

28. I am glad to say that all the assistants under me worked satisfactorily.

D. L. SAHASRABUDHE,

Agricultural Chemist, Bombay Presidency,

Poona.

APPENDIX K.

Work done under the Economic Botanist for the year 1922-23.

1. Dr. W. Burns, Economic Botanist, was in charge of this work throughout the year, except for the month of April, 1923, when he was on leave and Mr. G. B. Patwardhan acted for him. Mr. G. B. Patwardhan, Assistant Professor of Botany, was on leave for three months and nineteen days and Mr. L. B. Kulkarni acted for him. Mr. D. V. Narayanayya was confirmed as Assistant Economic Botanist with effect from 1st March 1923. Mr. W. V. Joshi, B.Ag., was appointed to act as Assistant Economic Botanist, vice Mr. Narayanayya, confirmed, who was working in the vacancy caused by the deputation of Mr. R. K. Bhide, as Plant Breeding Expert, from 1st March 1923.

Education.

2. The Economic Botanist and his teaching staff were, as before, responsible for the botanical side of the teaching of degree and special students. In the final year five men took Advanced Botany and Horticulture as their special subject and three of these passed. One student (a graduate of this College) was sent by the Cochin State for further botanical training. One graduate now on the staff of another College in Poona has been doing work for his M. Sc. thesis under the direction and advice of the Economic Botanist. One graduate belonging to the Department returned for instruction in the technique of measuring the thickness of tobacco leaves (a process required in tobacco breeding). Another graduate has been utilising the Botanical Section for special work on the internal structure of various parts of the coconut plant.

The students of the present final year (1923-24) have on their own initiative organised a students' Botanical Society.

Information.

3. During the year 456 specimens were identified in the Herbarium and 69 enquiries of all kinds were dealt with.

Research.

3-*a. Canal Weeds.*—The study of these weeds in the Mutha and Nira canals, in wells and tanks, and in cultures in tubs, has been continued. Among the interesting results of the year's work are the following:—

1. It has been found that several of these weeds have peculiar perennating organs, hitherto undescribed, which enable the weeds to tide over dry seasons, buried in the mud. Such organs, however, are formed only where the drying is gradual as in the case of a tank or well from which water slowly evaporates or is taken off. They do not form during the rapid emptying of a canal at a closure.

2. An experiment lasting from January to June 1923 was carried out to see whether by growing *Potamogeton perfoliatus* (the worst canal weed) in different conditions in tubs, we could get any indications

of the conditions favourable to weed growth. The four sets of conditions given were :—

Tub 1. Gravel substratum and silty water.

Tub 2. Gravel substratum and clear water.

Tub 3. Silt substratum and silty water.

Tub 4. Silt substratum and clear water.

Six plants were planted in each tub.

The siltiness in tubs 1 and 3 was maintained by stirring the water once every two hours during the day. In all tubs the water was changed every other day in order to approximate to canal conditions. The dry and wet weights of the total weed growth in each tub were taken in June 1923 with the result that the tubs stood in the following order as to luxuriance of weed growth :—4, 3, 1, 2.

It will be noted that the plants with the silt substratum grew better than those in the gravel substratum. Of the two tubs with the silt substratum that with the silty water grew less strongly than that with the clear water, while in the case of the tubs with the gravel substratum, the plants did better in silty water than in clear. The one point clear, therefore, is that silt suits the plants better than gravel to grow on, while the evidence as to the effect of silty water is conflicting. The experiments have been re-started in order to get further information on this important point.

3. Study of the Mutha Right Bank Canal during closures indicates

(*a*) that at each cleaning mostly only the above-ground parts of the weeds are removed and the underground portions left to propagate themselves.

(*b*) that the more thorough the cleaning during a closure, the longer does it take for the weeds to recover.

(*c*) that the thorough weeding of the gravel substratum near the dam itself has very considerably reduced the growth of weed there.

(*d*) a steady level in the canal is more favourable to weed growth than a fluctuating discharge.

4. The study of the actual percentage in silt from the Nira and the Mutha canals from samples sent during the year gives no indications of any kind. The siltiness in these fluctuates most unaccountably and with wide ranges.

The question of canal weeds was discussed at the Bombay Engineering Congress in November 1922 when the Economic Botanist was invited to attend. The difficulty in arriving at a conclusion in this matter is due to the fact that so many factors act on the weed simultaneously and that it has so far not been possible to devise, on a sufficiently big scale, an experiment which shall eliminate all but one variable factor. The factors are many but the following are some of them :—Light penetration of water as affected by depth and silt ; amount of silt as affected by amount sent down, by velocity, and by the nature of the canal bed and its section; nature of the salt, whether fine and colloidal or coarse and large-grained;

infection by certain species and not by others ; and so on. The Economic Botanist can deal with this matter only on a laboratory scale. What it really needs is experiment on a canal scale, and until the Irrigation authorities are willing to arrange and finance such experiments we shall not get much further forward.

4. *Seed Testing.*—From all sources, the number of seed samples received for testing during the year was 90. Of these 2 were for identification alone. Of the rest 38 were grass seeds and the rest crop plants. The majority of the samples were from Government Agricultural stations.

The experiment to test the longivity of crop seeds is being carried on as described in last year's report. So far there has been no marked drop in the germination capacity of any of the crops under investigation.

5. *Safflower.*—The collection of twenty-two pure lines of safflower received from Mr. A. Howard, Imperial Economic Botanist, was grown in three places during the year. Full notes were made on the physiological and morphological points of interest shown by these plants. Self-fertilised seeds were collected for the continuance of the lines in the following year and certain crosses were made. Out of the 22 varieties two appear to be heavy yielders. The yield per plant in No. 6 was 48 grammes of seed and in No. 7 it was 56 grammes. The third in order of merit yielded 18 grammes. Nos. 9, 11, 13 and 16 gave no yield. From the point of view of germination No. 1 did best, giving 58 per cent. and Nos. 17, 18 and 19 gave 50 per cent.

6. *Grass Investigators.*—The research on the improvement of poor grass land is financed by the Sir Sassoon David Trust. The enclosed area at KALAS continues to develop. Valuable perennial grasses have taken firm hold of the more hilly rocky areas and the tussocks of these are gradually covering the whole of the poorer ground with the concomitant exclusion of spear grass. In the lower levels the best wild fodder grasses locally known as Marwel, and scientifically as *Andropogon annulatus* and *Andropogon caricosus*, have established themselves to the absolute exclusion of all poor grasses. Burning, cutting and grazing having been absolutely prevented, there is annually the addition of a considerable amount of humus to the soil. There is still a period of two years to run before our lease of this ground expires. At the end of the period we shall be in a position to state exactly what can be expected in the way of fodder from this type of land when protected. There are thousands of acres of such uncultivable land in this neighbourhood and their improvement and exploitation so as to give the maximum of cattle food is a matter of considerable importance. The usual accurate botanical record of the changes in the vegetation of the KALAS area is being continuously kept. Work at Sirur has been given up as the rainfall there is too precarious. In other directions, however, the work of the research has been expanded. The committee in control of this work has been reconstituted and strengthened, and there is now complete co-operation between the Deputy Director for Animal Husbandry and the Economic Botanist, with the assistance of the Soil Physicist, all under the direction of the Director of

Agriculture. The first main point of expansion has been the inspection of the lands of Panjarpoles and Gowrakshans at the invitation of the authorities of these institutions. In many cases we have been able to make useful suggestions and in some cases there have been put at our disposal facilities for carrying out these suggestions. Notably at Kandivlee near Bombay, have measures been taken to increase and improve the yield of grass, and next year we hope to report considerable progress in this and similar spots.

The Director of the Vaccine Institute in Belgaum has also kindly put at our disposal two acres out of his paddocks in order that we may investigate the grass-producing capacity of both rich and poor soil there.

Similar experiments have been laid down at Bankapur, and wherever we are allowed to put our suggestions into practice.

The idea of all these experiments is—

(1) to see what the land will produce if given a chance,

(2) to devise a scientific system of rotation of grazing and rest whereby the maximum amount of fodder with the least damage to the herbage may be obtained. Such methods have been devised and put into action with great profit in America and such methods are similarly applicable here.

The plots of poor land in the Govern ent House compound which were improved by us from November 1915 to November 1st, 1922, and were thereafter returned to the authorities for general grazing, have been observed in the year under report. The broad facts are :—

(1) Spear grass (*Andropogon contortus*) has not succeeded in making its way back into improved areas.

(2) The perennial good grasses introduced by seed into the areas have continued and increased their growth.

(3) With two exceptions the annual grasses have disappeared.

The rains of 1923 will be a crucial season for these plots as they will the if be subjected to trampling and grazing during the growing season and the plots stand up to this we may consider the treatment a complete success.

7. *Weeds.*—The research on the eradication of the weed Lavala, (*Cyperus rotundus*) also financed by the Sir Sassoon David Trust, is nearing completion. The whole of the investigation and its results will be published in a memoir now in preparation. The method employed in this work was to study the life-history of the plant carefully by laboratory methods before planning any field experiments. This method has been fully justified. It has been found that though the plant produces seeds, these are not the main means of reproduction. In the most favourable conditions, namely, atmospheric humidity of 90 per cent. saturation, temperature of below 85° F. and monsoon conditions generally, only 1·5 per cent. of the seeds germinate and many of the seedlings die. We have, however, studied the development of seedlings into complete plants, and although the percentage of seeds that germinate is small, the total seed production in infested fields is so large that it is essential by cultivation to *prevent seed formation.*

The main means of reproduction is by underground tubers, and we have investigated carefully the conditions that affect the formation and germination of these tubers. The first act of the seedling is to form a tuber thereby assuring itself of a base for action. Later on, chains of tubers are formed in lower levels, some spreading horizontally and a few going deep, the latter apparently to function as the final bases for renewed growth in the case of continued drought in the upper layers. The maximum production of tubers occurs in the second foot from the surface. Experiments were made by artificially planting tubers three feet below the surface. Several of these reached the surface by the expedient of sending their reserve material ahead, forming a new tuber at a higher level and from this new starting place restarting growth. We have proved that the common method of hand weeding which means only the cutting off of the aerial parts is futile. It is an endless task, as it never by any means kills a sufficient number of the tubers to clean the area. The number of green shoots on the surface is not necessarily an indication of the number of tubers in the soil, and ten shoots may indicate anything from 50 to 350 tubers below ground. The green shoots can be killed by watering twice a week with a 2 per cent. solution of common salt, but this method has the effect of making the ground unfit for crops, so while it might be useful on a polo ground or a tennis court it would not do for agriculture. The conclusion is again reached that the tubers must be attacked directly, and this means turning them up by implements and exposing them to the sun. This year we have made experiments in incubators to test the effect of different temperatures on tubers exposed to heat in paper dishes and when covered with earth. The extraordinary vitality of the tubers then indicated itself, for it was found that a temperature of 104° F. for about a fortnight was required to ensure a high percentage of deaths. Our field experiments indicate that exposure for ten days to the heat and light of the sun when the shade temperature is from 90° to 104° F. also kills the tubers. Another method of attacking the tubers is to cover the ground so that the plant does not get a chance to grow; this can be done by piling actual rubbish, like cotton stalks, or by using a thick cover-crop. Our general indications are that a combination of ploughing and exposure in the hot weather, with cover (either dead or alive), will rid a field of this pest and that continued cultivation thereafter will keep it so. In addition to the practical points cleared up a considerable mass of knowledge of pure scientific value has been recorded from this intensive study of one species.

8. *Bajri Investigation.*—This is another of the researches financed by the Sir Sassoon David Trust. From the reconnaissance made in the Bajri districts 64 plants were got that seemed to be more drought resistant than their neighbours. The seeds from all these were grown in such a way that their pedigree could be easily recognised and in all 2,000 plants were obtained. Every single plant of the 2,000 was carefully studied and records kept of all its important characters. From this investigation several points have become clear:—

1. Bajri is in a very hybrid condition. Scarcely one of the original earheads gave a uniform progeny.

2. Taking the factor of hairiness, there are three recognisable groups

(*a*) those entirely hairless,

(*b*) those with hairs at the base of the leaves only,

(*c*) those hairy all over sheath, base and leaves.

3. Careful correlation studies show that the hairless ones are on the whole bigger plants with a smaller death rate and higher yield, and that, as hairiness increases, so do the size and yield decrease and the death rate increase.

4. There are, however, individuals which possess hairiness and also large yield. As we think that hairiness is probably associated with drought resistance we are giving special attention to the progeny of these hairy high-yielding individuals.

The sowings of bajri at fortnightly intervals throughout the year were continued. The following are the results :—

In the case of sowings made from mid-June to the end of August plants reach a height of one foot in 5½ weeks, begin to flower within 6 weeks, and finish half their flowering in eight weeks from sowing. In the case of sowings made from September onwards, these periods gradually lengthen till they reach their maximum in the case of sowings made in the end of December. For January and February sowings these maxima are maintained. They are eleven weeks for one foot of growth, twelve weeks for the first flowering, and eighteen weeks to finish half the flowering. From and including March and onwards the periods decrease until they again reach their minimum in June. These figures clearly indicate that the optimum time for sowing bajri is in June, July and August.

So much for the study of the plant ; but since we are dealing with the question of drought resistance, we have also devoted a good deal attention to the matter of the environment of the plant. Our efforts in this connection are directed to getting numerical expressions for :—

(1) the water-extracting power of the air,
(2) the water-delivering power of the soil.

To estimate (1) we have fitted up a small meteorological station with the usual thermometers. We have also done a lot of work with the adjustment and standardising of atmometers, which are instruments designed to read directly the evaporating power of the air. From Dr. Burton Livingston, who did the pioneer work on these instruments in America, we have got a set of six of his own standardised instruments and it is hoped with this equipment to get a satisfactory answer to the first question.

To estimate (2) is a matter of greater difficulty as so many factors are involved such as the size and nature of the soil particles, soil temperature, humus, rainfall and so on. We have shown conclusively the unsatisfactory nature of one method recommended by another scientist and have improved on this. The method is now under trial and something of the kind will eventually give us the thing we want. We shall thus have the debit and the credit sides of the plants water account and can say with what balance it can get along.

The above type of work is indicative of a trend in botany and other biological sciences whereby greater accuracy is demanded, coupled with mathematical expression of results.

9. *Eradication of Lantana.*—At the instance of the Director of Agriculture some investigations were made on methods of killing Lantana. It was found that a solution of sodium arsenite injected into the stem killed the plant rapidly. The roots and branch tips, on analysis, yielded indications of arsenic, showing that the poison had gone all through the plant.

Our next step was to invent a method of rapidly injecting the poison and to this end we experimented with both solid and hollow chisels, neither of which were satisfactory. We are at present rather balked but hope to get on again when this small obstacle is removed. We shall also have to discover some poison other than arsenic which is too dangerous to human life and too easily put to criminal uses to employ on a large scale.

Potatoes.

10. *Potatoes.*—(1) *Tambera Disease and its Treatment:*—

Approximately fifty acres of potato were sprayed or dusted against this disease in the rainy season of 1922. The results were in all cases successful. So much was this the case that the villagers of Donde, an out-of-the-way village in the Khed Taluka, sent us in a petition to come and spray their crop against the disease. We calculate that the outlay of Rs. 10 per acre on spraying will save Rs. 60 in yield. Taking the saving as only Rs. 30 net, so as to allow for poor years, bad cultivation, unfavourable market conditions and so on, and assuming the area under potato in the Poona district to be 5,000 acres, out of which we may assume on the average 2,000 acres affected, then the saving annually would be Rs. 60,000 to the cultivator. It is hoped to make the process of spraying with lime-sulphur-wash popular and self-supporting. To this end a leaflet has been prepared and distributed, and further demonstrations are being carried out in 1923.

A comparison of dusting sulphur by simple methods and more complicated machines, with spraying lime-sulphur-wash is in progress.

(2) *Varietal Trials:*—

Twelve excellent Scottish varieties, represented by four pounds of seed potatoes each, received from the well-known Edinburgh firm of Dobbie and Son were received and planted in the rains of 1922 and the succeeding cold weather season. These varieties did amazingly well. This is in distinct contradiction to previous experience in this part of India with Scotch varieties. These varieties are being grown on to study their behaviour in later generations. In addition, certain British varieties received *via* Bangalore were also tested. All were fairly good. Of the whole lot of varieties numbering 21, only 10 were retained for further trial so as to reduce the number of varieties to be handled and to weed out at once those whose performance was unsatisfactory.

None of these varieties proved Tambera-resistant.

(3) *Storage :—*

Potato tubers of the same origin were stored in three lots :—

(*a*) in cold storage in the cold store at the Crawford Market, Bombay, in a temperature of 36°F. to 40°F.

(*b*) in the storage house of the Union Agency situated on the College Farm temperatures from 75°F. to 90°F.

(*c*) in a heap according to the cultivators' methods in the village of Peth, temperature from 68° to 77°F.

The potatoes in cold storage kept perfectly. Moth present in such potatoes did not develop and died. The potatoes when taken out were not allowed at once to be taken into high temperatures and when planted germinated satisfactorily and gave good plants.

The potatoes stored according to method (*b*) suffered 3·2 per cent. loss from driage and 12·7 per cent. loss from rots.

The potatoes stored according to method (*c*) suffered 3·1 per cent. loss from driage and 13 per cent. from rots.

There is, therefore, a future for cold storage of seed potatoes during the hot weather in India.

(4) *Miscellaneous :—*

A study of the flowering and seed setting of the potato is in progress. A pedigree plot is maintained at Peth.

11. *Herbarium.*—The Herbarium was maintained in its usual efficient condition. 231 mounted specimens of plants were received from the Forest Botanist, Dehra Dun. We are arranging to send some of our duplicates in exchange.

12. *Publications.*—The Economic Botanist and his staff were responsible for the following publications during the year.

Dr. W. Burns, Economic Botanist—Two papers presented to the Indian Science Congress, Lucknow—

(1) The Ecology of Grassland.

(2) Variation in *Andropogon annulatus* and *Andropogon caricosus.*

Mr. L. B. Kulkarni, Assistant Economic Botanist—Two papers were presented to the Indian Science Congress held at Lucknow—

(1) Further change of Sex with andromonoecious Type of Papaya.

(2) Germination of Grass seeds.

Mr. D. V. Narayanayya, Assistant Economic Botanist, and

Mr. S. B. Ranade, Assistant Botanist—

(1) Perennating organs in Aquatics.

Mr. W. V. Joshi, Assistant Economic Botanist—

(1) Leaflet No. 4 of 1923, Tambera disease of Potatoes.

(2) Colour Deterioration of Potatoes, in the College Magazine.

Mr. T. R Khadilkar, Demonstrator in Botany—

(1) Paper sent to the Indian Science Congress at Lucknow on the growth of hypocotyl of *Dolichos lablab* as recorded by Farmers' Auxanometer.

Mr. S. B. Ranade, Assistant Botanist—Two papers sent to the Indian Science Congress, Lucknow—

(1) A Gall of Morphological interest on *Acacia Catechu* Var. *Sundra*.

(2) *Cyperus laevigatus* as a soil indicator.

Mr. S. V. Godbole, Assistant Botanist—Some criticisms on Mason's methods of determining directly the physiological humidity of the Soil. (Journal of the Indian Botanical Society.)

W. BURNS,
Economic Botanist.

APPENDIX L.

ANNUAL REPORT OF THE WORK DONE BY THE PLANT BREEDING EXPERT, POONA, IN THE YEAR 1922-23.

Staff.

1. I held the charge of the office of the Plant Breeding Expert to the Government of Bombay, Poona, throughout the year. Messrs. S. G. Bhalerao and N. M. Nitimargi, graduate assistants, were in charge of the Rice and Wheat Breeding Stations at Karjat and Kirkee respectively.

Rice Breeding.

2. The rice breeding work at present in hand consists of selection and study of strains of *Kolamba* rice, the most popular variety in the North Konkan, at the Karjat rice breeding station.

3. *Season.*—Though the monsoon started a little late this year, still when it started, the rainfall was almost continuous throughout the growing period of the crop. As a result the tillering was somewhat checked owing to want of sunshine and break in the rains. Besides, at the time of harvest it rained rather heavily for about a week and the crop was damaged in many cases owing to its lodging and getting spoilt by contact with mud. Thus the grains had either shed or begun to germinate and the harvested crop had a poor milling quality as the grains are prone to breakage when wetted after ripening.

4. *Method of Work.*—It was thought desirable this year to avoid as far as possible anything that might interfere with the normal behaviour of the plants either in the seed beds or in the fields as it was noticed that any advantage or disadvantage gained by any seedlings in the seed bed due to uneven spacing, exposure, or the like, is generally maintained to the last in the field. Similarly any advantage or disadvantage obtained in the field interfers with the normal behaviour of the plant.

So in the statistical study of such plants the frequency curves of their various characters are not as nearly normal as they should be. Hence this year not only were the seeds of single panicles sown equidistant in the trays like last year but they were also sown closer together, and around them a few rows of additional seeds from another sister panicle were sown in the same way, so that the central stock of seedlings forming the proper culture should all be under uniform advantage of space, exposure, etc. They were afterwards transplanted as the proper culture, the seedlings in the outside rows being used to form one border row on each side of the culture and two rows at each end. Any gaps in the rows caused either by death or by insufficiency of seedlings were also filled up with plants raised as rings in the trays such being marked to separate them from the main culture. The cultures were grown in four different series termed respectively (1) Intensive study, (2) undisturbed, (3) comparative and (4) extensive. In the intensive study series single seedlings were transplanted 9 inches apart in the rows and the rows were placed 18 inches apart. The undisturbed series was also transplanted with single seedlings but the distance between plants was 6 inches in the row

and the rows were 12 inches apart. The undisturbed series was grown with about 500 plants in each culture to have an independent idea of the yield per plant obtainable when the cultures were left undisturbed till the time of harvesting.

5. *Items of work.*—The principal items of this year's work were (1) to get a further confirmation of the purity or otherwise of the strains studied last year, (2) to determine the purity of some new strains taken up for detailed study this year, (3) to test again the yielding capacity of last year's strains and (4) to get an idea of the yielding capacity of the new strains. This is not the place to describe the characters of individual strains, but I have confirmed the purity of last year's selected types, and added others to those which are definitely pure. Eight new selections of Kolamba rice, moreover, were taken up this year for various characters as follows :—No. 3 for resistance to lodging, No. 113 for good tillering and for possessing some distinguishing character in the form of its very short awns or tips. Nos. 121 and 164 as coarse grained samples with good yields the latter being also intermediate in ripening; Nos. 134 and 153 for having fine grains the latter being also intermediate in ripening; No. 179 as an intermediate maturing and fine grained sample. Of these all except Nos. 113 and 179 were found to be pure.

Of the previous selections No. 42 resembling the Ghudya type of the Kolamba rice has continued to give over 25 per cent. better yields as compared with the average sample grown round about Karjat. It has been in great demand from the cultivators who have seen its performance. No. 72 has yielded nearly as high as strain No. 42 and may be equally useful. No. 6 has yielded less as compared with these above owing apparently to low tillering though it has the heaviest panicle in our lot. No. 35 which is definitely a fine grained sample resembling the *zinya* type which is expected to yield less than the coarse grained samples or the ghudya types, has actually yielded 8 per cent. better than the coarse samples of the Karjat cultivator. Had it been compared with an ordinary sample of the fine type obtainable in Thana to which it more closely resembles it might have shown still greater superiority as the comparison then would have been quite proper. Strain No. 32 which is also a fine grained sample like No. 35 has yielded even better than No. 35 and we can expect to get about 11-12 per cent. increase from it over the coarse samples of Karjat. No. 45 comes last among the lot. Its greatest disadvantage is its greater percentage of straw and chaff. Nos. 79 and 110, the early strains of our lot, continue to be so as regards period of growth and proportionate yielding capacity as last year though strain No. 110 yields somewhat less than No. 79.

These are my most promising selections, but there are many others with special qualities of their own, which are being retained for future use on account of these qualities.

6. *Some Noteworthy Features of the Selected Strains.*—No. 42 has always stood high in point of yield. Though it has a moderate tillering capacity still the tillers are mostly fertile. The plants do not run to leaf even if they are grown in fields which generally bring about that result in the

ordinary samples. This has been verified by some cultivators to whom the seed had been supplied and the Rice Specialist also found the same to be the case in his highly manured plots. Thus it seems to offer itself for further improvement by manuring. It can be planted closer without much risk of crowding. It has less sterility and is less affected by Smut than any other strains. It has a medium size of grain. From rough milling tests it may be said that the proportion of grain to husk is comparatively high though it may require a bit more polishing owing to its colour which is not clear white as is obtained in other types. No. 72 is nearly similar to No. 42. It has a bigger earhead but a lower tillering. No. 134 which is a fresh isolation, has a good tillering though from this year's observation it seemed that many of the tillers do not come to maturity. The size of the panicle is satisfactory and the grain much finer than in Nos. 42 and 72. In yield it seems to stand higher than any of the fine grained types on hand. It has less vegetative growth and hence might not run to leaf though it would require further testing. Nos. 32 and 35 belong to the fine grained type. No. 32 has a better tillering while No. 35 has a better and more compact earhead, though it is more prone to smut trouble. The former has a low straw production and might be benefited by manuring. Both of these being fine grained can command better prices in the market than the coarse grained samples. No. 79, an early strain, is getting popular in the Kolaba District and is grown on lands which used to grow inferior non-kolamba crops. Having a finer quality of grain than the non-kolumbas it can command higher prices as was evident from this year's transactions. No. 164 is perhaps finer than No. 79 and can also yield better as it takes three weeks more for ripening. It is also a better substitute for the non-kolumbas as regards yield and quality. No. 153 has a finer grain than No. 164 though the time of maturity is the same. Both are approximately similar in yield. The fineness of No. 153, however, will command better prices. No. 121 is perhaps the best in yield of the whole lot, but unfortunately it has a coarse grain which will detract from its quality and will not be able to command good price. No. 104 is a very late sample having the best tillering by virtue of its lateness. The yield is comparitively high but its grain size medium. It requires much water and does not lodge nor shed the grains. It can be recommended for fields containing water for a very long time in the season.

7. *Yields of the selected strains on the fields of the cultivators.*—We have been able to get fairly reliable records of yield from a number of cultivators, who grew our selections, side by side with the ordinary local seed. The following are the yields obtained by them on their own lands.

			Yields obtained.	
Mr. G. V. Medhi—from Vengaon	Strain No.	35	27·5	per cent. more.
Mr. S. G. Joshi—from Pinglas	,, ,,	42	26·2	,, ,,
Mr. B. D. Nimkar—from Pali	,, ,,	42	24·8	,, ,,
Mr. N. D. Marathe—from Karjat	,, ,,	79	16·3	,, ,,

In some cases it so happened that the late rains spoiled the harvest and the crop was damaged considerably.

Yields of the selected strains obtained on the farm.—As already stated before, the samples obtained from the neighbouring cultivators had been grown under uniform treatment as regards spacing of bunches and number of seedlings per bunch. Averaging the results of the yielding capacity of these samples and comparing the same with No. 42 it was found easily to surpass their yields by about 25 per cent.

8. *Rice Committee Meeting.*—The Rice Committee met at Karjat on March 2nd to consider the work of the year 1922-1923. The following were the findings of the committee.

"Rice strains Nos. 35, 42 and 79 which were grown on cultivators' fields in 1922 have given enough seed for 1,100 acres in 1923. The results show, when compared, an increase of 27·5 per cent., 26·2 per cent. and 24·8 per cent. on the local Kolamba late types (strains Nos. 35 and 42) and 16·3 per cent. on the local Kolamba early types (strain No. 79)."

If this be taken as correct, it means that if the 150,000 acres now under Kolamba rice in the North Konkan were to grow the selections now made and ready for distribution, it would mean the addition of 23,900 tons to the yields of rice and increased money value of production equal to over twenty-two lakhs of rupees.

Wheat Breeding.

9. The breeding work on wheat has been designed to provide types of both dry and irrigated wheat suited to Deccan conditions. The breeding station is located on the Ganeshkhind Gardens, Kirkee, while the Agricultural College Farm, Poona, is used for the trial of certain classes of selections.

10. *Cultures sown and history of crops.*—From the results obtained last year nineteen pure strains were grown this season both for further determination of their purity by taking plant to plant measurements and notes of their various characters and for noting their yield on an extensive scale. Two wheat samples obtained from local cultivators and one of Pusa 4 kindly supplied by the Imperial Economic Botanist were also studied for comparison of our selected strains with the cultivator's seed and with the standard variety Pusa 4. Thus altogether 20 strains were studied in detail this year including Pusa 4. The cultivator's samples were only useful for noting their yields per plant as they were all found to be more or less mixed.

Fortunately there was very little trouble from the surface grasshoppers and stem borers this year; and the soil fungi Rhizoctonia and Fusarium were also not very troublesome. The cultures had a good stand till after flowering, *i.e.*, the last week of January when the black rust *Puccinia graminis* began to make its appearance. Gradually it became so widespread that not a single strain escaped its attack. The attack was very severe in the first half of February. From the table given below it may be seen that in the beginning of this period the conditions were favourable for the rust attack, the temperature going high at day time and falling low at night. It is believed that the heavy rains in November and high

temperature and cloudy weather during January and Februar were responsible for the attack of rust.

Month.	Week.	Temperature.	
		Maximum.	Minimum.
January	1st	78·7	47·0
,, ...	2nd	83·5	55·8
,, ...	3rd	81·1	56·1
,, ...	4th	85·1	56·0
February	1st	88·7	55·7
,, ...	2nd	84·9	55·5
,, ...	3rd	84·7	56·0
,, ...	4th	83·0	57·7

Thus although we had no trouble from rust previously, the damage due to it this year was very great indeed and the yield was thereby much reduced. The attack was more severe in the case of dibbled cultures than in the case of drilled cultures. Similarly the cultures sown on the dry area at the College Farm suffered less or not at all while those on the irrigated area at Ganeshkhind Botanical Gardens suffered a good deal.

11. *Detailed plant to plant study.*—It was not possible to measure all the important characters of the grain that were thoroughly studied last season, and we had to remain satisfied with the study of the following characters only, *viz.*, height of plant, total number of tillers, length and breadth of the flag, date of flowering and the length of earheads. Yield per plant and other grain characters could not be studied plant to plant for two reasons. In the first place the grain development was not good owing to rust attack and secondly showers of rain also spoiled the plants in the end of February and March. The yield per plant was arrived at by noting the yield obtained from the whole culture and dividing it by the total number of plants in it. Frequency distribution regarding the other characters were worked out and the mean, mode and coefficient of variability noted for each. From the study of the frequency distribution of these characters and from the general observation of the reproductive characters it is believed that the strains are not only pure, but they would also have proved to be of sufficient economic value to justify their selection if they had not been affected by rust at the Ganeshkhind Gardens. This can also be seen from the results of their yield actually obtained on the College Farm on an extensive scale in comparison with that of the standard variety Pusa 4.

12. *Comparison with Pusa 4.*—On the whole the frequency distribution of the characters studied have been quite satisfactory in the case of every strain as compared with Pusa 4 which was treated and worked out similarly. The frequency distributions of this year were very nearly normal and showed a very great improvement over those of last year as there was a much larger number of plants available for study, there were fewer gaps in the cultures and the border effect had been left out of consideration.

13. *Rust resistance.*—During the whole course of the work on wheat no rust had ever appeared before and we had no certainty about the rust resisting capacity of the selected strains. And although it has to be confessed that none of the selected strains appeared to be very highly rust resistant under the present conditions, still many of them have shown some capacity to resist the rust attack. These strains are :—Nos. 103, 162, 167, 186, 200, 228, 237 and 278. The strains worst attacked with rust were 157, 168, 171, 210, 212 and 345 ; of these Nos. 168 and 171 are the early strains. They were equally affected with *Alternaria* trouble both at Ganeshkhind Botanical Gardens and at the College Farm, though they had no trouble of that kind last year. However, they not only showed a great difference in the degree of rust attack in the cultures grown at Ganeshkhind Botanical Gardens and those at the College Farm, but even different cultures of these strains grown in different plots of Ganeshkhind Botanical Gardens also showed appreciable difference in the degree of rust attack. It is believed that with a drier seed bed and with normal conditions of weather during flowering and grain formation they would have escaped the rust trouble. As it happened this year their grain was quite in the milk stage when the rust attack was very severe and hence their yield has been very badly affected. Pusa 4 was also attacked with the black rust and more especially in the dibbled cultures, but not to that extent which would be likely to reduce its yields appreciably.

14. *Certain selected strains*—(*a*) *New Khapli strain.*—The new *khapli* strain with the *kala kusal* characters which had been isolated had split up last year and various types had been isolated from its progeny. These types were grown this year separately to study their behaviour. One of these types appears to have bred true since all the plants in the culture were alike in respect of all their characters. Fortunately it has manifested an extraordinary power to resist the attack of black rust under the present conditions. In fact it was the only line that had almost entirely escaped the rust attack. Whether this was due to its late flowering will have to be determined in course of time though it may be said that another strain which had flowered later than this did show an appreciable amount of rust. The *khapli* strain with the *kala kusal* characters had been maintained so long with the idea that it might prove to be rust resistant ; it seems to have actually been so this year. The multiplication of this pure apparently very highly rust resistant type will be one of the future items of work on this station.

(*b*) *Bright seeded strains.*—Strain No. 52 with bright green leaves and bright coloured seed was grown this year as it had given rather good yield last year. In spite of the rust trouble it has given satisfaction as regards yield this year also. It would be worthwhile to breed rust resistance into it if possible by crossing with a suitable strain.

(*c*) *Waxless strains.*—The waxless Nos. 157 and 284 did not give satisfactory results regarding yield this year. They were both badly affected with *Alternaria*, the former being also very badly affected with rust.

(*d*) *Kala Kusal types.*—From the Kala Kusal types No. 278 was tried and its yield was found satisfactory.

(*e*) *High yielding strains.*—Of the good yielders of last year Nos. 210 and 212 were very susceptible to the rust attack and hence they suffered much as regards yield. The rest of the strains Nos. 186, 200, 162, 167, 224, 228, 237 mentioned last year have behaved well in spite of the rust trouble.

15. *Wheat Cultures at the Agricultural College Farm.*—The twelve cultures grown on an extensive scale here were the following:—Nos. 162, 167, 168, 171, 186, 200, 210, 212, 224, 228, 237 and 103. Each of these was grown in six different plots which differed more or less in the nature of the soil.

The strains were grown here as a dry-crop for which the monsoon was favourable as there had been about 4 inches of rain just after sowing. There was no great trouble from any fungoid diseases or insect pests except in the case of Nos. 168 and 171, which showed a premature drying up of the leaves due to *Alternaria.* Rats had also damaged the crop to a certain extent when the earheads were being filled up.

The results in yield of the various selections with Pusa 4 as a comparison were as follows :—

Strain Number.	Yield per acre calculated from the average of all repetitions in lbs.	Yield per acre calculated from that obtained from one in good soil in lbs.
103	1459·8	1878·8
162	1319·3	2158·0
167	1144·7	1416·8
168	1252·5	1509·2
171	1124·2	1386·0
186	1098·5	1447·6
200	1031·8	1509·2
210	1010·2	1324·4
212	1016·4	1355·2
224	1244·5	1817·2
228	1047·2	1602·6
237	1096·4	1570·8
Pusa 4	....	1540·0

It cannot be denied that these figures are exceedingly promising and it seems probable that if these various strains can be so multiplied as to cover the wheat area in the Deccan with in each case the most suitable type it will mean an increased money value each year of between fifteen to twenty lakhs of rupees.

In conclusion I have to place on record my appreciation of the good work done by Messrs. S. G. Bhalerao and N. M. Nitimargi and the manner in which their assistants helped them in the same.

R. K. BHIDE,
Acting Plant Breeding Expert.

APPENDIX M.

Report of Work done in the Plant Pathology Section during the year 1922-23.

Staff.

1. Mr. S. L. Ajrekar, B.A., held charge of the post of the Plant Pathologist till the 27th of January 1923, when his services were transferred to the Bombay Educational Department. The post since then has not been filled up but has been held in abeyance and the Plant Pathologist Section has been temporarily placed under the control of the Economic Botanist pending further orders from Government.

Mr. G. S. Kulkarni, M.Ag., Assistant Professor of Mycology, who was on deputation in Europe for study, returned and took charge of his office on the 3rd October 1922, relieving Mr. B. N. Vakil, M.Sc., who was acting for him. Mr. S. A. Jamadagni, Koleroga Fieldman, was transferred in May 1923 to the establishment of the Deputy Director of Agriculture, Konkan Division.

The services of Mr. J. D. Ranadive, B.Ag., which were placed at the disposal of the Plant Pathologist by the Potato Committee for assisting in the Mycological work in connection with the Potato Research, were terminated in September 1922 as the funds which were provided by the Sir Sassoon David Trust could not be obtained for further study.

Research.

2. *Potato.*—One of the objects of the writer's deputation to Europe was to visit Italy to study the potato industry with a view to submit proposals for the improvement of the crop in the Bombay Presidency. Accordingly, soon after return from deputation, on the knowledge gained by studying the potato trade and cultivation in Italy, a report was submitted to Government regarding the steps to be taken for the improvement of potato crop in the Presidency. It may be said that the whole question of improvement of potato cultivation is now well in hand under the control of a Committee of which the Director of Agriculture is the President and the writer is one of the members. The work is being pursued with the object of (1) finding and maintenance of high yielding potato ; (2) the checking of diseases, and (3) the best method of storage.

The results of the last year's work on the potato rots have been worked up into three papers and are submitted for publication.

Description of the four most commonly occurring potato rot fungi (two *Fusariums, Sclerotium Rolfsii* and a species of *Sclerotium*) have been prepared and their temperature relations studied.

3. *Cotton Wilt.*—The work on this has been carried on as outlined in the last year's report, in collaboration with the Cotton Breeders, S. D. and N.D., the main object being to discover or evolve a resistant variety. Inoculations are made in the field and in pots and the results worked up

at the end of each year. The following is a tabular statement of the results of the plots at Dharwar.

Name of Cotton.	No. of plants at the commencement of the experiment.	Plants killed by wilt completely.		Plants partly affected.		Total.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
1. Kumta Ordinary ..	419	65	15·5	104	24·8	169	39·1
2. Dharwar 1 ..	534	304	56·7	100	18·7	404	74·1
3. ,, 2 ..	414	84	20·2	44	10·6	128	30·8
4. ,, 3 ..	424	310	73·1	12	2·8	322	75·9
5. ,, 4 ..	250	174	69·6	20	8·0	194	77·6
6. ,, 5 ..	344	260	75·5	15	4·3	275	79·8
7. *Wagale* ..	431	18	4·4	5	0·6	21	41·0
8. Bishnur Jari ..	162	35	21·6	58	35·8	93	56·1
9. Rozi ..	212	161	75·9	15	7·0	176	82·9
10. F. of Dharwar 1 × Wagale	125	6	4·7	40	32·0	59	36·2

"Wagale" has withstood the attack of wilt remarkably well like last year. "Dharwar 2" and "Kumta ordinary" come second to "*Wagale*", but "Kumta ordinary" has done better than "Dharwar 2" this year. It indicates that as we are using the same Kumta seed once introduced on the farm some years ago natural selection of resistant types is going on in that seed. It also indicates that Kumta cotton contains types which resist wilt better than "Dharwar 2". A number of resistant plants in Kumta have been therefore selected to test this object.

The first generation of the cross between "Dharwar 1" and a pure wilt-resistant strain of Wagale indicates that resistence is dominant at least during the greater part of the growing period.

Susceptibility of Broach Deshi plants, Nos. 4, 5 and 6.—Pot culture experiments were conducted at Poona to test the above varieties of Broach cotton to *Fusarium* wilt with the following results.

Variety.	No. of plants grown.	No. of plants wilted.	Per cent. of attack.
1. Broach Deshi plant 4	8	8	100
2. Broach Deshi plant 5	9	5	55·1
3. Broach Deshi plant 6	10	*Nil.*	*Nil.*

It thus shows No. 6 is completely immune to wilt.

4. *Leaf spot and Blight of Onion.*—A study of this disease was continued. Inoculation experiments show that the fungus, a species of Alternaria, is a wound parasite. In one experiment, out of the six wound inoculations three were successful. In another experiment five out of seven were fruitful. High temperature and humidity were found to be necessary for the spread of the disease. Infected plants show the disease in a week.

Field experiments were conducted at the Kumta and Ratnagiri farms. Experiments at the Kumta Farm were inconclusive as the disease did not appear to any appreciable extent, but those at Ratnagiri indicate that Goa and Nandore varieties of onions resist the disease to a considerable degree. The application of sodium nitrate in small doses at intervals, combined with rab treatment, appears to be beneficial to the crop and the application of Burgundy mixture has no effect in checking the disease. The experience of two years of this disease has been, that the disease could be controlled by the following methods :—

(1) Proper selection of the seedlings.

(2) Low seed rate.

(3) Application of sodium nitrate in small doses at intervals to the crop.

(4) *Rab* treatment of the soil.

(5) Growing resistant varieties such as Nandore and Goa.

(6) Growing crop by the row method rather than by the bed method.

5. *General observations on crop diseases.*—(*a*) The study of the Mango infloresence blight has shown that, though hoppers are the constant associates of the trouble, a mildew is also concerned. Preliminary observations made in the important mango tracts (Ratnagiri and Dharwar) indicate that mildew is as important as the hoppers and in some cases it is the sole cause of the blight. It has also been ascertained that this fungus is considerably responsible for the dropping of the tender fruits. Heavy mists in the early mornings followed by cloudy weather which are generally considered to be the causes of blight, induce the mildew to grow very rapidly. Investigations hitherto made justify action against the disease and it is therefore intended to start operations in the coming season. (*b*) A group of obscure diseases on which some data have been collected is what are called the mosaic diseases. These diseases have been the subject of much investigations abroad and consequently a vast amount of literature on them is available. But in India no study of them has been made. Many of our crop diseases which were not understood hitherto seem to come under this Mosaic category. The *Katte disease* of cardamom which is being investigated by the Agricultural Chemist seems a typical case of Mosaic. Instances of this disease have been noticed in the chillie and tobacco crops. In the former, the affected plants get the leaf curl and in the latter the plants get stunted and the mottling of the leaves is highly pronounced. The potato and tomato crops are also subject to this disease. This year a severe infection of mosaic disease was noticed in the *mogari* crop (*Raphanus sativus var caudatus*) at the Agricultural College Farm, Poona. There is no doubt that mosaic diseases do exist in the Bombay Presidency and to some crops a considerable amount of damage is done by them. (*c*) An attack of an *Alternaria* fungus was noticed in the wheat breeding plots at the Ganeshkhind Botanical Gardens. The fungus grew on every part of the plants, stem, leaves, glumes and awns and interfered considerably with the yield of the crop. (*d*) *Betel-vine wilt disease.*—A great many complaints and enquiries received regarding this disease, especially from the Dharwar District, led to the necessity of making a prelimiary survey to

ascertain the seriousness of this disease and the possibilities of dealing with it. The disease is found in a good many gardens in the tract but is more serious at Savanur, where the betel-vine cultivation is very highly intensive. A *Fusarium* fungus is always associated with the roots of the wilted plants. (*e*) The life history of an interesting rust (*Uromyces Aloes* (Cke) P. Magn) on *Aloe vera* has been worked out and a paper on it has been sent to the Indian Botanical Society. This fungus is a useful addition to the teaching collection as it can be easily cultivated whenever required for class demonstration. (*f*) The field experiments on the smut (*Ustilago Eleusinis Kulk*) of *nagli* or *nachani* (Eleusine coracana) were again carried out at Malkapur with a view to see whether the smut was seed-borne or not. No smut appeared in the plot sown with seed infected with smut spores, nor in the plot sown with treated seed. These experiments which are being conducted for the last four years therefore go to show that seed treatment with copper sulphate is not useful since the smut is not seed-borne. (*g*) The results of spraying experiments conducted at Nadiad against the mildew disease of *jiru* crop (cuminum) were inconclusive as no disease appeared in the crop.

6. *Routine and Propaganda.*—The number of specimens of plant diseases that arrived in the Laboratory for examination from the public or from the department was 114. The following are new or not recorded previously in the Presidency.

(1) *Alternaria* Sp. on wheat.
(2) *Helminthosporium* Sp. on tobacco.
(3) *Acrothesium* Sp. on *jowar.*

The spraying campaign against the *Koleroga* or *Gal* disease of Arecca palms was conducted in the Honavar Taluka of Kanara and in the Dapoli Taluka of Ratnagiri District. A special point of interest in connection with this year's spraying campaign was the successful attempt to remove from the minds of the betel-vine growers the impression that the Agricultural Department was more anxious to push the spraying treatment than the growers themselves. This impression was perhaps due to some garden owners having received the treatment free of cost for several successive years in the past. This year the policy of not giving the treatment free except for the first trial was announced and rigidly adhered to, and although the work was started, owing to bad weather, rather late in the season the results achieved were undoubtedly encouraging.

The success of this year's campaign is to be measured not so much by the number of trees sprayed as had been the custom to do in the previous years as by the number of garden owners who were found willing to pay for the treatment. The number of trees sprayed was 9,905 as against 13,810 of last year, but the sum recovered for treatment given was Rs. 97-0-11 as against Rs. 24-9-7 of last year. This showed that the spraying treatment was appreciated by the people in spite of the several obvious difficulties of the methods. Further evidence of this appreciation was found in an article published on this subject in the "Kanara Leader" of October 17th, 1922, by the garden growers, praising the efficacy of the treatment.

This work has been carried on for the last ten years by the Plant Pathologist's section. From the coming year, the work has been transferred to the Deputy Director of Agriculture, Konkan Division, with a view to having a much wider and more effective extent of spraying propaganda.

7. *Teaching.*—The courses in Plant Diseases and Mycology for the B. Ag. degree was given.

8. *Publications.*—The following papers were submitted for publication during the year :—

(1) Relative Responsibility of Physical Heat and Microorganisms for the Hot Weather Rotting of Potatoes in Western India, by S. L. Ajrekar. This has been accepted for publication by the Agricultural Adviser to the Government of India.

(2) The Problem of Potato Storage in Western India, by S. L. Ajrekar. This was read at the 1922 Lucknow Science Congress.

(3) The Relationship of the Species of Fusarium causing Dry Rot and Wilt of Potatoes in Western India by S. L. Ajrekar and M. N. Kamat. It has been accepted for publication in the "Agricultural Journal of India."

(4) A Note on the Life History of Uromyces Aloes (Cke) P. Magn. by S. L. Ajrekar and B. R. Tonapy. This paper was read at the Indian Botanical Society Meeting at Lucknow, 1922.

(5) Potato Cultivation in Italy, by G. S. Kulkarni. This was read at the 1922 Lucknow Science Congress.

G. S. KULKARNI,
Assistant Professor of Mycology.

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APPENDIX N.

ANNUAL REPORT OF THE WORK DONE BY THE SOIL PHYSICIST TO THE GOVERNMENT OF BOMBAY, POONA, FROM JUNE 1922 TO JUNE 1923.

1. The work of my branch is mainly divided into two sections, *viz.* (1) Research and (2) Teaching. Help is also given to other branches of the Department who need it for the solution of problems in those branches. At the Tobacco Research Station, Nadiad, for instance, it was found that on a particular plot tobacco plants did not grow well unless they were irrigated at shorter intervals, than on other adjacent plots. The soils from both these plots were sent to me for examination and it was found out that a larger amount of water was rendered inactive by soil particles in one plot than in the other, owing probably to more accumulation of colloidal material in that plot and hence, few days after irrigation, the roots of tobocco plants were unable to extract sufficient amount of water for the proper growth of the plants.

Research.

2. As explained in my last year's report research work in my branch is so directed that it may be useful in keeping down, as far as possible, famine in food grains and fodder in districts of scanty rainfall. Research on soil from Mohol (in Sholapur District) was therefore undertaken last year and continued during the year under report with the object of finding out the means of increasing the water holding capacity of the soil, of making it retain moisture for a longer time and delivering it to the plant when needed.

It was found last year that the maximum water holding capacity of the soil could be increased by the addition of organic manures, such as farm-yard manure, fish manure, etc., as well as mineral manures, but as mineral manures for dry farming are of doubtful value inasmuch as most of them increase the osmotic pressure of the soil solution and thus render the entrance of water into the roots of plants more difficult, further work on mineral manures was postponed to a later date when more time and assistance would be available to find out which of the mineral manures would be more suitable.

It is, however, not enough if only the maximum water holding capacity of the soil is increased. The water absorbed by the soil must be gradually made available to the roots of the plants. This meant that soil should be supplied with organic colloids which should gradually change into non-colloidal material so that the extra amount of water which would be held by the colloidal material and rendered inactive in the beginning should be gradually made more and more available as colloidal material changed by gradual decomposition into a non-colloidal matter. It was thought that these conditions would be satisfied by studying the decomposition of green manure in the soil.

3. Soil from Mohol was, therefore, treated with one per cent. (0·25 per cent. dry matter) of green manure, chowli-Vigna Catiang and sufficient water added to wet the whole of the soil completely. It was then allowed

to dry and the first sample of soil was taken twelve days after the addition of the green manure. Soil was again wetted with sufficient water and allowed to dry. Second sample of soil was then taken after twelve days. This process was repeated and fresh samples of the soil were taken at an interval of twelve days for over a period of three months. The samples of the soil were then tested for (1) maximum water holding capacity, (2) added water rendered unfree, (3) water held by the soil against a particular centrifugal force. The results obtained are very promising as the following figures show.

Sample.	Maximum water holding capacity.	Added water failing to freeze per cent. (Bouyoucos method).	Water retained after centrifuging (3,000 revolutions per minute).
1	2	3	4
Untreated Mohol soil	82·76	56	40·51
Sample No. I (12 days after adding green manure)	90·60	74	41·95
Sample No. II (24 days after addition of green manure)	89·37	100	40·61
Sample No. III (36 days after addition of green manure)	87·50	100	40·71
Sample No. IV (48 days after adding green manure)	86·80	86	40·74
Sample No. V (60 days after adding green manure)	82·73	88	40·90
Sample No. VI (72 days after addition of green manure)	....	78	40·78
Sample No. VII (84 days after adding green manure)	....	76	40·88
Sample No. VIII (96 days after adding green manure)	....	72	40·83

These figures are very significant. The figures in the second column show that the maximum water holding capacity of the soil is increased by about 8 per cent. within 12 days after the addition of green manure. It then gradually falls down to its original level about 60 days after the addition of green manure. This indicates the possibility of increasing the inherent capacity of the soil (apart from keeping the soil porous for the proper penetration of rain water) to store rain water for nearly two months. It remains to be seen how advantage can be taken of this property actually in field practice.

Figures in the third column show that the power of the soil for holding water more firmly or its retentive capacity for water can be greatly increased within about a month after the addition of green manure. After about a month it gradually gets less and less but even after 96 days it does not fall as low as it was before the addition of green manure. This means that for full three months and more the retentive capacity of the soil can be maintained at a higher level.

Figures in the fourth column show that the power of the soil to hold water against a particular centrifugal force is increased by about 1·4 per cent. twelve days after the addition of green manure, but this small increase also mostly disappears in a few days.

If we were to compare the power of the roots for extracting water from the soil particles to the centrifugal force, forcing out water from the wet soil we might say from figures in the fourth column that the water-delivering power of the soil is not materially changed, so that the increased amount of water as shown by figures in the second and third column will not be held against the force of the roots coming in contact with the soil particles.

4. So far the results of green manuring obtained by Laboratory methods are hopeful. How far they can be utilised in field practice and how far the provisional conclusions drawn from them are correct will be seen only when experiments are done actually in field. In near future experiments will be done in the field also and the utility of the Laboratory experiments will then be further tested.

Teaching.

5. Teaching Soil Physics to the students of the Intermediate Agricultural Class formed a part of my duty during the year under report. Students' practical work in the Laboratory is efficiently carried on by Messrs. H. M. Desai, B.Ag., and B. P. Deshpande, B.Ag.

Staff.

6. During the year under report I had no trained assistant to help me in my scientific work. But during the coming year one graduate assistant and one non-graduate fieldman are being appointed and with their help I hope to make more progress.

V. A. TAMHANE,
Soil Physicist, Bombay Presidency, Poona.

APPENDIX O.

Summary of Work by the Deputy Director of Agriculture for Animal Breeding, for 1922-1923.

1. Mr. E. J. Bruen held charge of the duties of the Deputy Director of Agriculture for Animal Breeding for the year. He acted as Secretary to the Committee appointed by Government to investigate and make suggestions regarding the cattle breeding industry and fodder reserves of the Presidency. Plans and estimates were prepared in consultation with the Imperial Dairy Expert for two large Dairy concerns to supply milk to Bombay City and at the same time to prevent indiscriminate slaughter of good milch cattle as at present prevails owing to the method now employed to supply Bombay with milk. All private and co-operative cattle breeding societies were visited and advice given where possible. A scheme was drawn up and accepted by the Khandivalee Gowrakshak to improve the institute and bring it into line with other scientific Breeding and Dairy Farms.

2. During the year four very successful Cattle Shows were held. It is very encouraging to see how these shows are being recognised as centres for teaching and demonstrating the value of good cattle, as in Dharwar District alone some six shows were held by different Co-operative Bodies. These shows have been fairly liberally supported by the District Local Boards and private persons. Special credit is due to Rao Saheb S. S. Mangsoli and Mr. S. K. Wodeyar, Mamlatdar of Athni, for the keen interest displayed and the great help rendered in Athni, Taluka.

3. During the last quarter of the year Government were pleased to hand over cattle breeding operations in Sind to this Department. This includes the Willingdon Cattle Farm for Sindhi cattle.

4. Government now have breeding farms for the Kankrej, Amrit Mahal, Sindhi and Thar-Parkar breeds of cattle. There are still the Mhaswad and Tapti Khillari, the Krishna Valley, Dangi and Gir breeds to be provided for. A very big demand has already been created for Mhaswad Khillari bulls. Unfortunately it is getting very difficult to procure good bulls of this breed, those that have been put out were bought in Native States.

5. All the members of the staff have worked very well and great progress has been made especially in the Central and Southern Divisions. Very little head-way has been made in Gujarat and the demand for bulls is not nearly as great as it might be, considering the very large field open to this work.

6. The work under the Deputy Director of Agriculture for Animal Breeding is divided up as follows :—

(1) Production and Experimental Work on Stud Farms.

(2) Propaganda and village improvement.

7. *Production and Experimental Work on Stud Farms.—Northcote Cattle Farm, Chharodi.*—Mr. M. M. Desai, B.Ag., held charge of the Northcote Cattle Farm for the year with Mr. B. B. Jamaspjina, B.Ag.,

as Assistant Manager of a portion of the year and Mr. M. G. Patel as Assistant Manager for the remainder. Mr. M. M. Desai and his staff have worked well throughout the year.

The monsoon was fairly good. During June about 4·81 inches of rain was recorded. The early part of July was dry giving time and opportunity to sow a greater portion of the fodder crop. During the last week of July 7·92 inches of rain was recorded, the total rainfall for the year being 28·29 inches in a total of 32 days. The even distribution of the rain was very beneficial to the fodder crops.

The hay crop was a very average crop except for the low-lying areas where the water stagnates and spoils the crop, the total hay harvested amounting to 10,46,768 lbs. The actual cost of the hay when stacked worked out at Rs. 4-9-5 per 1,000 lbs.

In addition to the hay crop last year's experiment in growing the high yielding Surat varieties of fodder *jowar* were continued. The season being peculiarly good for fodder *jowar* all the varieties sown made very rapid growth. The growth of the *Sholapuri, Perio,* and *Sundhia* varieties was so rapid and rank that a great deal of the crop was lost owing to its lodging. All that portion that paid to harvest was collected and the remainder was grazed for one month by 400 head of cattle at night. An attempt was made to collect seed from a portion of the crop, owing, however, to the damage done by birds, only sufficient for the use of the farm could be obtained.

Sundhia was grown as a hot weather crop and gave good green feed during the summer; it is not, however, a commercial proposition in this tract owing to the high cost of preparing the land and of irrigation. The land having been heavily manured the previous year only, a portion on which Sholapur *jowar* was grown was manured at the rate of 20 carts of farm-yard manure per acre. There is now no doubt that given a fair year and good manuring, fodder crops can be grown to advantage in this tract. The actual profit varied from Rs. 50 to Rs. 70 per acre.

Two small plots were sown to sunflower in the kharif season. The land received no particular attention, and no manure was given this year. The last year the area was sown to *Sundhia jowar* and *rabi val* and castor; these crops were manured to the extent of 33 carts per acre of farm-yard manure. Both plots were sown in the third week of July at the rate of 40 lbs. per acre with the Surat wheat drill at 18 inches apart. A small portion was reserved for seed. An attempt was also made to sow sunflower in the *rabi* season when the crop yielded 5,950 lbs. of green fodder per acre, provided it was away from large shade trees. Where trees were near, it failed. In the kharif season it yielded, however, 25,000 lbs. of green fodder per acre and gave a handsome profit.

During the year 494,762 lbs. of silage was made and the three *pucca* silo towers on the farm were filled with this material, as well as five *cutcha* ts.

8. *Live Stock at the Chharodi Farm.*—During the year several experiments were conducted on the Farm. The absence of housing, tying and proper feeding arrangements makes these experiments very difficult,

but experiments are in progress regarding the value of bran as a food stuff for *Kankrej* cattle, the value of clothing cattle in connection with milk yield under Upper Gujarat conditions, the correlation of the local methods of judging cattle with the western system and the cost of raising cattle in Gujarat.

The breeding operations on the farm continue, much improvement has been noticed from the use of the pedigree bulls now heading the herds. During the year seventy-seven cattle were cast and sold, the purchase of these animals being restricted entirely to actual breeders. Butchers and traders were excluded. The tract has gained to the extent of these animals.

The milking experiment is particularly encouraging. From the milking herd, the following strains have been selected :—

Name and number of the animal.	Ik yield.		Remarks.
	Lbs.	ozs.	
1. Hirali No. 130 ..	2,034	4	During a period of 12 months.
2. Todor „ 72 ..	1,618	8	Do. do.
3. Surjam „ 123 ..	1,514	8	During a period of 8½ months.
4. Lilor „ 135 ..	1,567	12	Do. 7½ „
5. Sabarmati „ 116 ..	1,343	4	Do. 12 months.
6. Mojoli „ 215 ..	1,277	8	Do. 9½ „
7. Chanothi „ 271 ..	2,079	8	Do. 12 „
8. Lachor „ 42 ..	1,321	12	Do. 11½ „
9. Manchhi „ 229 ..	1,179	8	Do. 8 „
10. Padol „ 361 ..	1,347	12	Do. 9 „
11. Todor „ 124 ..	2,422	4	Do. 8½ „
12. Putli „ 227 ..	1,058	0	Do. 6½ „
13. Khajan „ 272 ..	1,264	8	Do. 6½ „
14. Reshum „ 122 ..	2,627	0	Do. 3⅔ „

The yields are very good considering the conditions under which milch cattle are maintained at Chharodi. Cow No. 14 in the above list (Reshum) unfortunately aborted but with all this she yielded her highest yield in her flush being 29 lbs. 8 ozs. per diem.

During the year previous the milk was sold as milk, during the current year a separator was installed, the result being that the farm made Rs. 147 over and above last year's return, besides the calves had the benefit of the separated milk which they lost when the milk was sold as whole milk.

During the year under report the farm was fairly free from epizootic diseases. Foot and Mouth Disease occurred during August. The preventive measures taken by the Farm Manager soon helped to eradicate this disease. The year under report is one of the first years during which rinderpest had not made an appearance. Whether this is due to the climatic conditions prevailing or to the fact that the cattle were inoculated by the serum simultaneous method the year previous, it is difficult to say. The death-rate has considerably dropped due to better feeding and the casting of old animals. During the year the farm put out two buffalo-bulls and nineteen cow bulls on the premium system.

10. *Finance of the Chharodi Farm.*—During the year the farm accounts show a loss of Rs. 21,617 as against Rs. 33,633 of the year previous. This loss is chiefly made up of loss in difference in realisation on cattle sold to book value, a loss of Rs. 2,250 on petty construction and repairs, a loss of Rs. 1,000 on the revision of prices of all dead stock, and the valuing of all farm produce to cost price. It is very difficult to make this side of agriculture a profitable business and particularly so at Chharodi, which depends on its revenue to the season. The raising of good pedigree stock is expensive and at present the people do not realise the value of good pedigree stock.

11. *Cattle Breeding Farm, Bankapur.*—The farm was managed throughout the year by Mr. A. B. Gadagkar, G. B., V. C.

The rain broke in June and for the first month good rain fell but unfortunately a long break during July and August put back the grass and forage crops considerably. However, the rains were good and timely enough to give fair results.

During the year, 2,40,000 lbs. of hay was harvested at a total cost of Rs. 667-10-3. 72,000 lbs. of green grass was converted into silage, this helped considerably during the hot months of the year.

The farm consists of an old fort, consequently there is practically no land available for cultivation. Two small plots were cleared of debris, and brought into fit enough condition to grow *jowar*. The two plots measuring about two acres produced 19,028 lbs. of green fodder which was converted into silage. A very satisfactory second crop was obtained which was fed to the cattle green. Efforts are being made to level and bring under cultivation some more land.

With regard to the herd of Amrit Mahal cattle, I am pleased to say that during the year under report the farm was once again free from disease. The only deaths recorded were of four small calves killed by a panther. The strength of the farm at the end of the year was 145 animals of all classes or an increase of ten on the previous year. During the year twelve animals of all classes were sold and seven bulls were put out on the premium system. During the year thirty-three male and female calves were born.

The farm is as yet not fully equipped for experimental work, and it is encouraging to see that in the second year of its working the farm has been in the position to put out seven bulls on the premium system.

The farm is still very short of housing for man and beast. It was originally intended that the farm would keep and maintain 20 head of cattle, buildings were accordingly arranged for this number. The strength of the herd as will be seen is now 146 and is likely to increase. A shed to house these animals and likewise accommodation for workmen are urgently required. The farm has pulled on by erecting cheap temporary buildings, which have up to the present met our requirements and now even this space is inadequate. The farm still obtains its water supply from a three-inch bore hole by a pump worked by hand power and it requires a mechanical water lift with storage tanks.

The farm held its first cattle show with very encouraging result. The Collector and Captain Meherban Nawabsaheb of Savanur were present together with most of the leading gentlemen of the district.

On the whole the Bankapur farm has made very good progress both in the live stock and in reclaiming the land. It was many years before Chharodi Farm was able to produce suitable bulls to be of use to the improvement of cattle but it is satisfactory to be able to report that Bankapur Farm has made a very fair start in its second year. The Amrit Mahal breed does exceedingly well in this tract and I feel that we are now producing as good cattle at Bankapur as is being done in the indigenous home of the breed.

12. *Willingdon Cattle Farm, Phihai—near Karachi.*—Cattle breeding operations in Sind were taken over from the Civil Veterinary Department in February 1923. This includes the Willingdon Cattle Farm at Phihai.

The Willingdon Cattle Farm has consisted of about 820 acres of rough grass land, a few acres of which were cultivated on the farm. It has a large well from which irrigation and drinking water is pumped by a four-inch centrifugal pump.

The breeding herd consisted of the following pure Sindhi stock:

Bulls	6
Youngstock bulls	3
Bull calves	16
Draught bullocks	2
Cows	22
Heifers	12

During the months of February and March 1923 the whole farm area was fenced, cattle byre and store room erected. The following cows were purchased. Sindhi cows—10, Thar-Parkar cows—4, Thar-Parkar bulls—1.

The object of this farm is to establish a strain of high milk yielding Sindhi or Red Karachi cattle, suitable to the tract, at the same time keeping in view the draught requirements of the tract. A small herd of Thar-Parkar cattle has been placed temporarily on this farm. The Thar-Parkar is a hardy high milk yielding breed, the male stock of which are good draught cattle. This excellent breed fills a very necessary demand for the Central and Lower Sind, and should be in great demand in future both in Sind and in Central India.

13. *Propaganda and Village Improvement.*—This work is divided into three areas termed the Northern, Central and Southern Division, each division being under a Divisional Inspector of Cattle Breeding. The work of these officers consists in visiting all the villages in their tract, where lectures are delivered on the improvement and care of cattle and on the conservation of fodder in the form of hay, *kadbi* or silage. To induce the people to use good stud bulls, good bulls are purchased in consultation with persons desirous of taking a bull and these given on a liberal premium system.

During the year the grant for this purpose, Rs. 2,500, was exhausted, the demand being very brisk. All bulls given on the Premium System were inspected. During the year the following bulls were given out on Premium System :

Northern Division. .. 19 Kankrej Bulls, and 2 buffalo bulls,

Central Division. .. 7 Mhaswad Khillari bulls,

Southern Division. .. 6 Amrit Mahal and 1 Krishna Valley bulls,

or a total of 33 bulls, or nine bulls more than the year previous, were put out.

During the year in the three Divisions over 500 villages were visited by the Divisional Inspectors.

Four well attended Cattle Shows were held by the Department. The following statement will show how popular such shows are getting.

	Cattle attending.		
	1920.	1921.	1922.
Northern Division, Chharodi, Kankrej breed..	100	403	634
Central Division, Mahud Budruk, Mhaswad Killari	....	180	400
Southern Division, Bankapur, Amrit Mahal..	....	....	209
Athni, Krishna Valley	....	....	1,985

These activities have reaped wide-spread results in most of the villages in which this department is now working. The villagers have purchased pure-bred cows discarding their scrub and mongrel bulls. The castration of mongrel bulls is also on the increase, several villagers in the Dharwar District offering all entire bulls for castration since Premium Bulls have been stationed in their villages. The placing of good bulls in villages has been a hard business as it is an entirely new business, the people relying on bulls dedicated to temples to do the necessary services.

However, from the results obtained from bulls put out, the people are beginning to realise the benefits of using good pure bred bulls. Unfortunately, the demand far exceeds the funds devoted to this business. Greater progress could be made if the maintenance charge of Rs. 4 which is inadequate were raised to Rs. 10 and if Government increased the budget under this head.

14. *Staff.*—Most of the staff have worked well during the year. The clerical staff have had a very busy year with the Cattle Committee and for a greater portion of the year have worked with one man short. Mr. V. K. Gokhale and Mr. Y. K. Phadke have put in yoeman service and with all the extra heavy work have kept the office upto date.

E. J. BRUEN,
Deputy Director of Agriculture
for Animal Breeding, Poona.

APPENDIX P.

Annual Report of the Agricultural Engineer for the year 1922-23.

I held the charge of the office of the Agricultural Engineer to Government during the year under report in which a great change in the general nature of the work, administration and finance has been effected as a result of the recent Devolution Scheme passed under G. R. No. 5427, R. D., of 1st December 1922. The executive control of the most of the branches in Agricultural Engineering including boring, pumping, cane crushing, etc., has been distributed to the six divisions in the Presidency. The transfer of a number of machines, considerable grants and a big staff has also been effected. Each division now under a Deputy Director of Agriculture is thus equipped with a mechanical assistant, a boring assistant, a boring mechanic and two or three boring mukadams according to the number of boring machines allotted. Another change is in the general administration of the Agricultural Engineer's workshops and stores which has been effected according to G. O. No. 3515, R. D., of 16th January 1923, the idea being to restrict the work carried out at my shop to a minimum, dispensing with the extra muster roll employees and the temporary establishment entirely and limiting the activities of the department to advisory, experimental and research work. The department has in addition to look to the inspection of boring and other Agricultural machines transferred to the different divisions, advise in technical matters, act as a resource in case of accidents and breakdowns, control the pumping plant at Nangaon, supply estimates, drawings and designs for various agricultural schemes after visiting the sites, undertake erections of new plants like the Karajgi, etc., work the famine sets in case of necessity and experiment with tractors and other agricultural implements.

2. The bringing of the Devolution Scheme into force took up considerable time and energy, consequently I am unable to show very much progress in the general activities of the Department, as the change was actually effected from the 1st of February last and most of time from the end of last monsoon when all the executive works are usually slack has been spent in making preparation for the proposed transfer of men, grants and material. I am, however, giving below a brief history of the work done during the year under report before and after the Devolution Scheme.

3. Although inquiries for agricultural machinery are on the increase, requests for actual purchase or erection are very few indeed as the prices of machinery have not as yet reached the normal. There were, however, two pumping plants fixed, one in Thana district at Koregaon for Mr. K. T. Karulkar of Umbargaon consisting of a 10 B.H.P. oil engine and a four inch pump on the river Varoli, and the other in Surat at Lawacha for Mrs. Sardesai consisting of a 16 B.H.P. Tangye engine and a three inch Ruston centrifugal pump on a well recently bored. The first plant is owned by the cultivator himself while the second is a Government plant hired out to the lady at a cost of Rs. 450 per annum.

4. No inquiry has matured in cane crushing, ginning, etc., but there is a general cry for motor tractors and similar labour and cattle saving devices. The case tractor and the Grand Detour plough have ploughed about 40 acres of land in Khandesh in spite of one or two serious breakdowns which kept the work at a standstill for many days. The steam ploughing tackle from Ranebennur was given on hire to Sardar Maha-boob Alikhan of Savanur for a sum of Rs. 3,000. The Sardar experimented with the deep plough intended for Karnatak for eradicating *Hariali* weeds and also the other implements such as Cultivator, the shallow plough, the Disc plough, and the Zigzag harrow. Although he had the assistance of some of the departmental hands given on deputation for carrying out the work and training new men, still the expenditure was slightly more than what was expected. The Sardar is, however, anxious to have the tackle on hire again for the next year which is sufficient proof of its usefulness. The motor plough cannot be said to have arrived at the stage of perfection as yet and I shall require some little time to give a correct opinion of its utility when compared with cattle power. There is, however, very little chance of success until individual holdings are increased in size or co-operative societies come forward to manage such concerns.

5. The power baling plant at Karajgi had to be left incomplete for want of funds. The storage shed, the machinery shed and the foundations for the machines are completed and the remaining work will be taken up as soon as funds are available. I hope, however, to run the plant by December next and I shall deal with the entire scheme later on in my next report.

6. The pumping plant at Nangaon fixed on the river Bhima for experimental purposes is greatly appreciated by the *rayats* and Government has recently been pleased to increase the perennial irrigation from 45 to 60 acres. But there is a demand for further increase in the area under perennial irrigation and although the plant is partly duplicated it is not possible to consider the proposal unless the plant is completely duplicated.

7. The object of the Devolution Scheme is to increase the quantity of work by more effective and timely supervision. It is to be seen how far this aim is attained and we shall be able to say something next year when the Divisional Officers have conducted the work for one complete year. There are two new boring schemes before Government. One is the exploratory boring and the other famine boring. The object of the first is to test the possibilities of water as a preliminary measure to sinking a well. The bores intended for this will not exceed a depth of 50 feet. The second is intended as a recourse in times of heavy drought. Although both the schemes are costly in capital expenditure still they are very useful and essential in the interest of the *rayats*.

8. There is often great difficulty in obtaining a trained man to work a boring machine at the present time as this line of work is entirely new. The difficulty will be more pronounced when carrying out the above two schemes and hence a class for training candidates in boring at the shops, similar to the one for training oil engine drivers, is essential.

9. This year I had an opportunity of staying in Sind for more than six weeks, during which time most of the machinery has been inspected and several agricultural implements tested with a view to modify them to suit the local demands. Ploughs such as the *Raja*, the Monsoon, the Egyptian and the Orient, etc., were tried on different soils under various conditions and the Orient was found to be the most efficient and suitable to meet all demands. Its cost, however, is very much in excess of the Egyptian plough, the latter being commonly used in Sind and it is only possible to advocate the Orient implement when the cost is considerably reduced. I am going into the details of this to see how cheaply it can be manufactured and I am confident I can reduce it by half. The Cletrac tractor did excellent work at the Jacobabad Farm where the soil is very light and the combined operations of ploughing and sowing at one time were a great success.

10. The oil engine class has been held at the workshops for cultivator students and I think this course will go far to solve the problem of getting trained men to drive small power plants and run them successfully.

11. This year my office was removed to Barrack No. 13 in the College compound and this is the fifth shifting since 1913. The stores which were arranged in another barrack behind the College were also removed to the shops after the Devolution Scheme was sanctioned. This shifting business is very expensive, troublesome, and leads to breakage of furniture in transit, displacement of goods and at times the losing of papers, etc. A proper office building and store house is the only solution to avoid such trouble and unnecessary expenditure.

12. The enquiries received during the year under report are as under:—

1.	Pumping	20
2.	Cane Crushing	5
3.	General	43
4.	Boring	70

Number of acres ploughed in Khandesh by tractor plough is 40 acres and 10 gunthas.

Number of students trained in the oil engine driving class is 12.

The number of bores made by the department until the date of the transfer of work, *i.e.*, 1st February 1923 is 14, details of which are as under :—

Name.	Place.	Taluka.	Depth.	Result.
Ahmedabad District.				
1. Calico Mills ..	Ahmedabad ..	Daskroi ..	223′	Incomplete.
2. Mr. Somabhai Sankalchand ..	Dholka ..	Dholka ..	63′	6,000 gallons per hour.
3. Mr. Ambalal M. Mali ..	Madalpur ..	Daskroi ..	95′	Successful.
4. Mahant Baldeodas ..	Dakore ..	Thasra ..	19′	In progress.
5. Mr. Ashabhai Chatoorbhai. ..	Kabudthal ..	Daskroi ..	140′	Successful.

	Name.	Place.	Taluka.	Depth.	Result.
	Broach District.				
6.	Mr. Khudabax N. ..	Ankleshwar ..	Ankleshwar ..	24′	In progress.
7.	Mansuklal P. ..	Vedach ..	Jambusar ..	75′	In progress.
	Surat District.				
8.	Mr. P. V. Bhiladwalla ..	Pardi ..	Pardi ..	96′ 6″	Successful.
	Poona District.				
9.	Bhandarkar Research Institute. ..	Poona ..	Haweli ..	100′	250 gallons P. H. Successful.
10.	Do. ..	Do. ..	Do. ..	125′	In progress.
	Thana District.				
11.	Mr. Moreshwar T. Desai.	Malad ..	Salsette ..	27′ 6″	In progress.
	Belgaum District.				
12.	Mr. K. H. Huilgolkar ..	Amapur ..	Athni ..	175′	In progress.
	Dharwar District.				
13.	Mr. Chapsi Parbati ..	Hubli ..	Hubli ..	159′ 6″	Successful.
14.	Mr. Ramangouda Udagawdar ..	Hulkoti ..	Gadag ..	111′	In progress.

13. For some years now I have been swamped by administration detail and my real duties such as the designing, experimenting and development of the technical side of Agricultural engineering have had to take second place. Since the sanction of the Devolution Scheme, however, my duties may be summarised as below, to experiment with pumps, water lifting devices for agricultural purposes, assist cultivators requiring pumping plants as hitherto, investigate the possibilities of pump irrigation from rivers and plan schemes both for Government (famine and general) and for private land owners, to erect power baling plants, and the like belonging to Government, to act as consultant and inspecting officer in all the boring work and to make a special study of agricultural implements. The above are as a result of the Devolution Scheme my specific duties and I hope next year to have some real progress to report on the design and manufacture of agricultural implements and the working of power machines throughout the Bombay Presidency.

14. During the year under report a complete stock taking and rearrangement of all machinery and machine parts has taken up a considerable portion of the time of my best men. The famine sets are being thoroughly overhauled and grouped so as to be ready the moment they are required.

15. I am pleased to say that my staff has worked well and is thoroughly reliable.

W. M. SCHUTTE,
Agricultural Engineer to Government,
B. P., Poona

APPENDIX Q.

Annual Report of the Horticultural Section for the year 1922-23.

1. On 30th July 1923 the Horticultural section will complete its two years of existence in the Agricultural Department. In addition to last year's programme of research and the usual advisory work, teaching and other routine duties, fruit improvement work in Sind and district nursery work in the Presidency and foreign enquiries have offered a heavy task for the members of this section. In fact no where would retrenchment measures have been so keenly felt as by the Horticultural section where advisory and research work has increased by leaps and bounds and funds cut down to a minimum.

Staff.

2. There is no change in the staff of the Horticultural section except the appointment of Mr. G. B. Deshmukh as a Graduate Fieldman in the Ganeshkhind Botanical Gardens, Kirkee, and transfer of Mr. V. V. Dongre from the Plant Breeding Expert's establishment to this section.

Grants at the disposal of the Horticulturist.

3. (1) Office of the Horticulturist, including the District Horticultural Officer .. .. Rs. 575

(2) Ganeshkhind Botanical Gardens.

Year.	Sanctioned budget grants.	Expenditure.	Receipts.
	Rs.	Rs. a. p.	Rs. a. p.
1920-21	13,300	13,261 8 9	3,847 15 1
1921-22	17,415	12,414 13 4	7,542 3 8
1922-23	9,475	9,128 7 2	5,413 13 6

(3) Modi Bag, Poona.

Year.	Sanctioned budget grants.	Expenditure.	Receipts.
	Rs.	Rs.	Rs. a. p.
1920-21	5,000	5,000	....
1921-22	14,875	14,826	378 9 3
1922-23	6,808	6,808	1,233 11 3

Investigation.

4. The activities of the section in investigation are distributed within various branches of the Horticultural section as suggested in the previous report. Want of Laboratory apparatus mentioned and scarcity of

travelling allowances have been keenly felt both in our investigation and advisory work. At any rate various branches of this section have always co-operated and thus have greatly substantiated the progress of the work. Three research papers have been accepted for publication in the Agricultural Journal of India, as will be seen from the accounts given below.

5. *Laboratory investigations.*—Laboratory investigations are mostly confined to the study of fruit juices such as pomegranate, lemon, orange, toddy, *jambhul* and *kashew.*

Pomegranate juice.—Local pomegranates have been found to contain as much as 14·6 per cent. of sugar, with soft seeds. Observations bring to light that differences in sugar contents, colour and quality of seed are mostly due to seed variations and this crop could be immensely improved by selection and subsequent vegetative propagation. The juice of the local pomegranate preserves well for about one year and promises a good business as has been found in various discussions with the juice-dealers both in Bombay and Poona. Sour pomegranate contains 4·60 per cent. of acid. Bottled juice is a good relish for table use.

Lemon juice.—There are four distinct types of *kagdi* lemons. The acid contents and taste of *kagdi* lemon compare favourably with foreign types. The acid contents of *kagdi* lemon growing in the Konkan, Maharashtra and Gujarat are identical and the average acid content is less than with most foreign types. The juice keeps well and opportunities for lemon cultivation and development of lemon juice industry in the Presidency are great. At present 1,58,204 lbs. of lemon juice is imported into India.

Jambhul.—There are two kinds of *jambhuls.* The wild variety is not very tasteful for fresh use. It is sharp in taste. It contains as much as 17·35 per cent. of total sugars and 1·21 per cent. of acid. The juice of the cultivated variety contains an average 12 per cent. sugar. This juice has been found to stand any amount of rough handling. Its taste is temptingly good and its colour is attractive and most economical when compared with other juices in the market. Its juice when pasteurised at 65°C for 35 minutes, keeps well in store. Fermented juice has got a deep red colour and is quite thick. *Jambhul* grows in abundance over very large areas in the Bombay Presidency.

Packing improvements.—Early in 1923 at the request of Mr. Manakchand Kishandas of Utran special demonstration in picking and packing of oranges was given to the workers. The use of measure rings in picking helped to cut down the daily labour to about 10 per cent. and proper grading and packing brought four annas more per basket as compared with other packages in the market of Delhi.

Mangoes in cold storage.—Our first experimental despatch of mango fruits in cold storage was sent to England in the year 1922. All fruits reached London in sound condition. Several boxes were kept in the cold storage (40°F. temperature) at the Crawford Market, Bombay. *Pairi* mangoes are found to keep well for seven weeks. Cold storage fruits keep in saleable condition for five days in the month of July at Poona.

Of course the range of temperature variation is small. Unripe mangoes stand cold storage temperature very well but under normal atmospheric conditions lose colour of the skin soon after they are taken out of the cold storage and allowed to ripen.

Drying of Figs.—Local figs contain 17 per cent. sugar. They are not fertilised. Still they have been successfully dried for commercial purposes without any loss of flavour. They are bleached in sulphur for ten minutes first and by exposure to sunshine, they dry up to one-third of the original weight in about five days. Such produce has been much appreciated by people. Drying is one of the means which can regulate the fig-supply in the market and ensure better prospects for the fig growers.

6. *Investigations in the Ganeshkhind Botanical Gardens, Kirkee—Grape.*—The progeny of high yielding vines marked as a result of selection has not borne any fruit as yet.

Partial self-sterility is noted in Pandhari Sahebi. Partially self-sterile types could be greatly improved by cultivating them side by side with perfectly self-fertile types. An effort to develop new varieties which would give better yield and resist climatic conditions better than existing types is steadily improving. All seedlings grown from naturally fertilised seeds and hybrids are growing luxuriantly and show considerable variations in their vegetative growth.

Raisin grapes for Sind have been imported from Kabul and the United States, Department of Agriculture. Shikarpur Municipality have offered facilities to undertake such trials in their own gardens for the benefit of the people in Sind.

Root exposure.—Further tests confirm that in grapes the influence of root exposure on the formation of fruit bud is not very marked. Root pruning seems to be useful for crops where wounds heal comparatively quickly.

Die back of orange.—Results of experiments are now available. Trees revive but the rate of revival is not very economical. As die-back of orange is the commonest trouble in the Presidency and is likely to remain so, as it is due to the soil conditions so characteristic of the Presidency. The only recommendation which this department can make at present is to advise orange growers to get their sites examined before planting trees. Results are being compiled to throw full light on this subject.

Packing of mango plants by post for long distances.—A paper by Mr. P. G. Joshi, Superintendent, Ganeshkhind Botanical Gardens, Kirkee, on this subject has already been accepted for publication in the Agricultural Journal of India, Pusa. Grafts, after hardening, can be packed in boxes with soil and sent by post to over-sea dominions covering forty-eight days journey in living condition.

Rice improvement.—A paper on this subject is submitted by Mr. P. G. Joshi, Superintendent, and it has been forwarded for publication in the Agricultural Journal of India at Pusa (*vide* No. A.-5174 of 7th July 1923 from the Director of Agriculture). Square sowing method of rice

seedlings in Konkan gives as good yield as transplanting and the cost of cultivation is much minimised.

Potato seedling raising.—A good deal of work on this line is on record. The life of seedlings is prolonged by successive transplanting to make them bear tubers. The maximum weight of a tuber borne by Green Mountain seedlings is about 1·5 ounces. Seeds from Italian tubers growing in the Gardens have been collected and their progeny is under test.

Banana seedlings.—An extensive crop of banana seedlings has been successfully raised. So far as vegetative growth is concerned there is very little variation. They are not yet of an age to bear fruit. This is an effort to develop new types.

In addition to these main lines of investigation work other activities in hybridizing types of guavas and developing new types of guavas, roses and some other plants are in hand.

7. *Investigation in the Modi Bag—Stock experiments.*—Differences in vigour and growth in the progenies of individual wild mango trees have been observed to be very prominent in our experiments. Characters which combine a good stock are still undefined.

Eir lemon stock has been preferred to common *jamburi* stock for citrus fruits by many expert propagators. *Eir* lemon seed has now found a way into commercial nurseries, a step which justifies more than enough the economic value of our work in this direction. Results will be submitted for publication soon. Our stock of plants of *jamburi* are also marked and the productiveness of their progeny is under observation.

Notching.—A paper on notching by Messrs. Cheema and Gandhi has already been accepted for publication in the Agricultural Journal of India, Pusa. Notching helps to start growth of dormant buds and consequently gives good shape to the plant, and increases yield. Notching will be done on a large scale in the year 1923-24 and its influence on the yield of fig trees will be demonstrated to the fig growers.

Oiling of figs.—This operation which is so freely practised in Southern France has been observed to hasten maturity of Poona figs to about two weeks. Hastening the maturity of figs without giving even the least injury to the plant (as in the case of local practice of root exposure), is a matter worth consideration. Details as to the method of oiling the fruits and the subsequent influence of oil in hastening the maturity are being worked out.

Seedless Papaya fruits.—Seedless condition of papaya fruit is due to lack of cross pollination. Seedless fruits could be produced by bagging female flowers of certain trees but the size of fruit is greatly reduced. There seems to be a correlation between the number of seed and the size of fruit.

Vegetable improvements.—(*a*) Potato :—Large number of new types have been developed as a result of seedling raising. Report of the fourth crop has already been made and the results seem decidedly promising. (*b*) Tomato :—"Greater Baltimore" and "Bonny Best" varieties are

superior in quality to our country type but inferior to it in yield. Pure lines of all types are being developed to test the influence of selection on yield and to furnish reliable material for hybridization.

8. *District and Advisory Work.*—During the course of last year 300 enquiries are recorded. All enquiries have been dealt with, and whenever for want of investigation enquiries could not be disposed of experiments have been undertaken.

The greatest difficulty which has been felt in improving fruit cultivation in the Presidency is due to unreliable nursery and seed business. This difficulty has been recognised by the public on many an occasion as could be seen from the increasing demand for opening district nurseries for the benefit of fruit growers. This district nurseries scheme is already under trial for the last 14 months at Kolhar (Ahmednagar) where growers have considered it a valuable achievement on the part of the Horticultural section and where villagers as well as school boys have taken an equally keen interest to learn propagation work. In addition to the budding of Citrus stock and grafting of mangoes, a considerable number of wild *jujube* trees have been budded by our people. Four teachers of the Urdu school at Kolhar deserve credit for their sincere co-operation with us. The extension of this district nursery system will be of immense value in increasing fruit output in the Presidency of Bombay.

Requests for starting nurseries have also been received in this branch of the department. One from Dharwar and another from Sangamner, but for want of hands to take up the work the request could not be fulfilled. The request of the District Agricultural Association of West Khandesh to start a nursery in that district could not be fulfilled on account of various reasons, but a private cultivator at Nachankheda in East Khandesh has started a nursery of fruit trees, and this Department has supplied him with stocks, plants and other material. This arrangement is economical to the department and fulfills the object of the Agricultural Association.

Apart from this 10,936 fruit plants have been distributed free of charge to public schools, hospitals and to other correspondents, who have expressed a keen desire to give them a trial in new tracts at their own expense.

The District Horticultural Officer, who is exclusively an advisory officer, has spent fifty-seven days out in the districts to solve the difficulty of the growers on the spot. In addition to this our sincere and genuine efforts to demonstrate to the people the method of destroying mango borers, spraying against citrus scale fly insects, preparing estimates for commercial orchards, and propagation of Naval oranges for free distribution in the Presidency are undoubtedly worth mentioning.

There is a considerable loss in orange gardens due to a moth which punctures the fruit at night time and does considerable havoc in the crops which ripens in the rainy season. In certain cases the loss is as heavy as 30 per cent. The moth was so far absolutely unknown to the

cultivators. Considerable work was done in the last year's rainy season at Rahuri and certain other places. The remedy is only hand picking the moth at night time. The expense is about 8 annas for the whole season and personal trouble of catching the moths at night time. The moths concerned chiefly are various species of Ophideres and Nyctipao. When a puncture has been made by these species the juice is often sucked also by Annua coronata and Ophiusa tirrhaca and two more species of Ophiusa so far not indentified. Work on these pests will be continued in this season also. During the year under report a class in elementary Arboriculture was held in November and December last to which four students attended.

Mr. H. P. Paranjpye's book in Marathi on fruit crops is almost printed out and the book will be ready for the public in about a month.

Mr. H. V. Gole of Nasik has also written a book in Marathi on Grape cultivation and will also be available, to the public in about a month. These two books will be useful to the public in solving their difficulties in horticultural matters.

9. *Work in Sind.*—Considerable attempts have been made to explore possibilities of fruit culture in Sind. This work was undertaken at the request of the Director of Agriculture, Bombay, Poona, in connection with the request of the members of the Sind Zamindars' Association. The results of our investigation are already submitted to the authorities. It needs no further emphasis that a very large part of Sind is eminently suited to the cultivation of Dates, Raisins, Lemons and Figs.

G. S. CHEEMA,
Horticulturist to Government,
Bombay, Poona.

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No.	Year.		Price. Rs. a. p.
61	1914	Sugarcane, its Cultivation and *Gul* Manufacture	0 5 0
62	1914	The Value of Castration of Deccan Bullocks	0 3 0
63	1914	Substitute for Rab	0 3 0
64	1914	Alkali or Kalar Experiments and Completion Report of Daulatpur Reclamation Station in Sind	0 14 0
65	1914	A list of diseases of Economic Plants occurring in the Bombay Presidency	0 4 0
66	1914	Indigenous Implements of the Bombay Presidency ..	2 2 0
67	1914	An Examination of the Seed-Supply of the Sholapur District ..	0 3 0
68	1914	A Note on Well Boring	0 5 0
69	1915	The Rice Stem Borer in the Konkan	0 3 6
70	1915	Improvement of Cotton in the Bombay Presidency (except Sind)	0 3 6
71	1915	The Grape Growing in the Nasik District	0 9 0
72	1915	Experiments with the Automatic Water-Finder in the Trap Region of Western India	0 4 0
73	1915	Hand List of Plants, Seeds and Bulbs available for distribution in the Ganeshkhind Botanical Gardens, Kirkee	0 2 0
74	1915	Well Water from the Trap Area of Western India	0 6 0
75	1915	Note on Cattle of the Bombay Presidency	0 3 0
76	1915	Artificial Manures—Experiments on their value for crops in Western India	0 4 0
77	1916	Fodder crops of Western India	0 11 3
78	1916	Some wild fodder plants of the Bombay Presidency ..	0 13 0
79	1916	The Cultivation of Guavas in Gujarat	0 5 6
80	1916	List of Seeds available on the Agricultural College Farm, Poona.	0 5 3
81	1916	Note on Fencing Construction	0 6 9
82	1916	Cultivation of drilled paddy in South Bombay Presidency ..	0 9 0
83	1917	The Spice Gardens of Sirsi in Kanara	0 10 6
84	1917	Seed Selection Series—Kumpta Cotton..	0 1 0
85	1917	Note on Cattle in the Bombay Presidency	0 11 0
86	1917	Establishment and Management of the Dairy Farm ..	0 7 0
87	1918	The Utilisation of Inferior Grass Herbage, Experiments at the Tegur Cattle Farm	0 9 0
88	1918	First Report on Fruit Culture as practised round about Tharushah (Sind) in Nawabshah District	0 2 0
89	1918	Artificial Manures: Experiments on their value for crops in Western India	0 3 3
90	1918	Work on the Manjri Farm for the years 1915-18	0 7 3
91	1919	The Cultivation of Berseem in Sind: Experiments at Sukkur ..	0 1 0
92	1919	Classification and Description of the Jowars of the Bombay Karnatak	0 10 3
93	1919	Palm *Gul* Manufacture in the Bombay Presidency (principally Date Palm)	1 3 9
94	1919	Sugarcane Borer and its Control	0 4 3
95	1919	The Cultivation of Oranges and Allied Fruits in the Bombay Presidency	0 2 6
96	1920	Investigations into the manure of the Salt Lands of Sind ..	0 12 0
97	1920	Prickly-Pear as a Cattle Food	1 4 0
98	1920	Fruit Culture as Practised near Shikarpur, Sind	0 1 6
99	1920	The Rice Cultivation in the Larkana District, Sind ..	0 8 0
100	1920	Fodder Crops of Western India	2 1 0
101	1920	Fruit Culture in Palitana and Jamnagar	0 8 6
102	1920	Investigation of Potato Cultivation in Western India ..	1 15 0
103	1920	The Book of the Mango	3 5 0
104	1920	The Ganeshkhind Botanical Garden, Kirkee (Its Genesis and Development)	0 15 9
105	1920	The Groundnut Bug and its Control	0 2 0
106	1920	Dharwar American Cotton: Its History, Cultivation and Improvement	0 7 0
107	1921	Gonag—a weed in Drilled Paddy	0 5 0
108	1921	Summary of the Work done on Jalgaon Farm	0 5 6
109	1921	The Crops of the Bombay Presidency, their Geography and Statistics	2 13 0

No.	Year.		Price. Rs. a. p.
110	1922	Year Book of the Agricultural Department in the Southern Division	0 5 0
111	1923	A Note on Well Boring	0 8 0
112	1923	Improvement of Grazing Areas in the Bombay Presidency ..	0 11 6
*113	1923	Year Book of the Agricultural Department in Sind Division..	
114	1923	Studies on the Rice Plant and on Rice Cultivation.. ..	0 13 0
115	1924	Shevri as a Fodder Crop	0 3 0

*In the Press.

Annual Report.

Report of the Department of Agriculture, Bombay Presidency, for the year 1922-23.

GOVERNMENT OF BOMBAY.

REVENUE DEPARTMENT.

Resolution No. P.—51.

Bombay Castle, 25th March 1924.

Letters from the Director of Agriculture No. A.—8200 dated 3rd November 1923 and No. A.—1152 dated 12th February 1924—Submitting a copy of the Report of the Department of Agriculture, Bombay Presidency, for the year 1922-23.

RESOLUTION.—Cotton research occupies the premier place among the activities of the Agricultural Department. As a result of these activities in the Gujarat tract the pure strains of Navsari cotton have now spread all over the area south of the Nerbudda and the percentage of Goghari is reduced to two or three. The department is now concentrating on selection 1027 A. L. F. The total area of this cotton under the control of the department was 84,000 acres during the year. 21,60,000 lbs. of the improved seed were purchased by the department and disposed of to cultivators. The notifications and rules under the Cotton Transport Act have recently been brought into force in this area with a view to prevent the import of inferior cotton into the area for mixing. It is hoped that the Agricultural Department with the co-operation of the people and the help of the Cotton Transport Act will soon be able to make the tract of country between the Nerbudda and the Par rivers famous for the quality and purity of its cotton.

2. Government regret to observe that inspite of the great expansion of the area under improved seed the work of distribution of the seed has not been taken over by co-operative agencies to any great extent. The special attention of the Director and the Registrar of Co-operative Societies should be drawn to this point and they should be requested to report to Government what obstacles there are to the growth of co-operative cotton sale societies like the Sonak and the Islampur and how they can be removed. Their attention should also be drawn to the arrangement reported by the Deputy Director, N. C. D., under which the Dhulia Co-operative Bank has taken over the purchase of the seed grown by registered cultivators and its distribution to co-operative bodies. Government would like to see this arrangement extended to all areas where the distribution of seed has progressed beyond the stage of departmental management.

3. In the Southern Division the success of Dharwar No. 1 has been assured. Improved seed for 65,000 acres was distributed through co-operative societies during the year. The Cotton Transport Act has been applied to the Kumta area also, as it was found that inferior cotton from long distances was being imported by rail into Hubli, Gadag and other places for mixing.

4. The problem of cotton in Sind has now assumed great importance owing to the starting of the Lloyd Barrage works. A Committee has been appointed to consider the whole question of agricultural development in Sind to meet the new conditions created by the Barrage. The special difficulties of Sind regarding the supply of improved seed of staple crops have been described by the Deputy Director. The department has taken up an area of waste land on the Jamrao canal to multiply improved seed. Government are also giving financial assistance to import seed from outside the province but ultimately the people will have to form co-operative organizations of their own for the purpose.

5. Generous grants have been made by the Indian Central Cotton Committee for the investigation of four specific problems of cotton cultivation as mentioned by the Director. The solution of these problems or any of them will add considerably to the wealth of the cotton growers.

6. The important experiments carried out by the Plant Breeding Expert at the Research Station at Karjat have borne fruit. The improved strains isolated by him, particularly No. 42, have been proved to yield over twenty-five per cent. more on the cultivators' fields than the ordinary variety hitherto grown. About 1,200 acres were planted with the improved seed in the year under report and distribution over 10,000 acres is being arranged for the current year. It remains now to organize and finance the wholesale distribution of the improved strain throughout the area of 20,000 acres in the Northern Konkan which grows this variety of rice and Government trust that this will be achieved with the help of the Co-operative Department.

7. Investigations on other staple crops like Jowar, Bajri, Nagli and Wheat are in progress. In the case of the last the Plant Breeding Expert is reported to have evolved pure strains with a higher yield than the local types, suitable for the Deccan. They should be tried on the cultivators' fields and if successful, their large scale distribution should be organized. The isolation of similar strains for Jowar and Bajri will take time, but Akola Bajri when grown in Khandesh is reported to have given much higher yields than the local types and is in great demand. The most important practical work on Jowar during the year has been the organization of a campaign for steeping the seed in copper sulphate solution against smut. The campaign was conducted with the help of the Revenue Department and Government are pleased to learn of its success. It is hoped that efforts will not be slackened but intensified hereafter so that the treatment may become universal within a few years.

8. As regards the research work of specialists other than the Plant Breeding Expert, no striking practical results have been achieved as yet. Government recognize the importance of time in the case of scientific research, but it is essential that the work should be directed into the right channels in pursuance of a well defined policy so that time and energy may not be dissipated in numerous aimless pursuits. Government have decided to retain all the specialist officers against the advice of the Retrenchment Committee, but it is necessary that the Horticulturist and the Soil Physicist should show that their investigations are tending towards some practical results even if none have been achieved so far so as to justify the retention of their posts. Government consider that the work of the Soil Physicist should not be confined to the laboratory and regard his work at Manjri as a move in the right direction.

9. In the case of the district staff Government consider that an increase in the number of fieldmen and graduates is necessary for propaganda work, but until the financial situation permits the increase, they would urge the advisability of concentrating the staff on a few selected Talukas on activities specially chosen by the Deputy Director as suitable to the tract rather than dissipating their efforts in a number of directions over the whole district. Government are pleased to note that numerous demonstration plots were laid out on the cultivators' fields. They regard this as the right method of demonstration and would like to see it being made use of more extensively in all the divisions.

10. It is highly gratifying that the Divisional Boards and Taluka Development Associations have made a very promising beginning. They can rely upon the cordial support of Government so long as they are willing and able to help themselves and serve as centres of agricultural and co-operative development within their areas. Government would urge upon all Taluka Development Associations the advisability of getting themselves registered under the Co-operative Societies Act and developing the co-operative as well as the agricultural side.

11. The report of the Cattle Committee is under the consideration of Government. The establishment of new farms and extension of existing ones is mainly a question of funds. Some Gowrakshans have responded to the offer of co-operation on the part of Government and provision is being made in the budget for financial help to such bodies. Government have also sanctioned an annual grant to the Shirpur Agricultural Association for maintaining the Tapti-Khilari breed. The amendment of the Cattle Trespass Act on the lines suggested by the Cattle Committee is engaging the attention of Government.

12. The Agricultural College has turned out a good year's work. A new Agricultural school was opened at Surat during the year.

13. It is hoped that the Agricultural Engineer will be able to achieve some tangible results in the developing and improvement of agricultural implements and the working of power machines now

that he has been relieved of a good deal of routine administrative work. Several Deputy Directors report a good demand for iron ploughs for hire. This work may be taken up on a large scale by Taluka Development Associations and Co-operative Societies. The advisability of establishing implement depôts in suitable tracts may also be brought to the notice of makers and agents of agricultural implements.

14. Government emphasized the importance of boring in their review of the administration report last year. They regret to notice that the progress made in the year under report has been very poor. The charges for the use of boring machines have been revised and reduced by the orders in Government Resolution No. 7074 of 17th September 1923 and Government have undertaken to bear the cost of supervision, interest, depreciation and repairs. The Director is requested to report what hinders progress in this direction and to suggest remedies. The advisability of entrusting the work to local bodies on the same terms as those sanctioned for the Kaira District Local Board should be considered. Government propose to sanction a grant of Rs. 34,000 from the Famine Insurance Fund for purchase of new power machines and adaptation of old ones and intend to concentrate efforts on two selected Deccan districts liable to famine.

15. No branch of the activities of Government is fraught with the possibilities of greater benefit to the masses of the people than the work of the Agricultural Department. The Director and his staff realize this and Government desire to accord their thanks to them for their labours.

By order of the Government of Bombay
(Transferred Departments),

A. R. DALAL,
Deputy Secretary to Government.

G. R. No. P.—51, R. D., dated the 25th March 1924.

To

The Commissioner in Sind and the Commissioners of Divisions,
All Collectors including the Deputy Commissioner, Upper Sind Frontier,
The Director of Agriculture,
The Registrar of Co-operative Societies,
The Superintendent, Civil Veterinary Department, Bombay Presidency,
The Superintendent, Civil Veterinary Department, Sind and Rajputana,

The Principal, Bombay Veterinary College,
The Private Secretary to His Excellency the Governor,
The Director of Public Health,
The Director of Information,
*The Municipal Commissioner for the City of Bombay,
*The Agricultural Adviser to the Government of India,
*The Secretary to the Society for the Prevention of Cruelty to Animals,
*The Government of India,
*The High Commissioner for India in the United Kingdom.

* By letter.

No. of 1924.

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